FIFTH ANNUAL REPORT

OF THE

MICHIGAN ACADEMY OF SCIENCE

CONTAINING

AN ACCOUNT OF THE ANNUAL MEETING

HELD AT

ANN ARBOR, MARCH 26, 27 AND 28, 1903

PREPARED UNDER THE DIRECTION OF THE COUNCIL

BY

JAS. B. POLLOCK, SC. D., SECRETARY

BY AUTHORITY

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FIFTH REPORT

OF THE

MICHIGAN ACADEMY OF SCIENCE

LETTER OF TRANSMITTAL

To HONORABLE A. T. BLISS, *Governor of the State of Michigan:*

SIR:—I have the honor to submit herewith the Fifth Annual Report of the Michigan Academy of Science, for publication in accordance with Section 14 of Act No. 44, of the Public Acts of the Legislature of 1899.

Respectfully,

JAS. B. POLLOCK.

Ann Arbor, Mich., December 1, 1904.

TABLE OF CONTENTS.

MICHIGAN FLORA.

BY W. J. BEAL, SC. M., PH. D.,

AGRICULTURAL COLLEGE, MICHIGAN.

INTRODUCTION.

The first Michigan Flora entitled a "Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Michigan, Indigenous, Naturalized and Adentive," was prepared by Charles F. Wheeler and Erwin F. Smith, and was printed in the report of the Michigan State Horticultural Society for 1880.

The second Michigan Flora, based on the first, was prepared by W. J. Beal and C. F. Wheeler and was printed in the report of the Michigan State Board of Agriculture for 1892. Of the second Michigan Flora one thousand separates were printed for distribution and the supply was exhausted in less than five years.

The copies of all the former edition of this Flora were distributed chiefly among botanists of all grades from Professors in Universities and Colleges, Normal Schools, teachers in High Schools, Academies and among amateurs. It is believed that this edition notwithstanding all its defects, will encourage many to study the wild plants of Michigan not forgetting the arrivals from other countries. Besides assisting the student in becoming familiar with names of species and their distribution, it should be useful in other respects.

Within the past few years a delightful department of botany has attracted much attention. It is emphatically outdoor work and is known as Ecology or the relations of plants to their environment.

This Flora may help the student in his investigations of plant groups or plant associations, noting those peculiar to certain kinds of soil, and others growing almost everywhere. It will aid in listing natives and exotics. Students can make many lists, such as those forming rosettes, those that climb, those that thrive in the woods in early spring, those that grow in strata or layers above each other or in zones within and without each other. It should aid in the study of plant dispersal by all sorts of methods and in the multitude of ways by which plants protect themselves.

The following is a list of the chapters found in the last edition of the Flora that are omitted in this edition:

Planting the Roadside and about the Home.
Planting a Grove.
Planting a Wild Garden.
Autumn Foliage.
Native Trees and Shrubs selected for the Color of their Leaves in Autumn.
Native small Trees and Shrubs distinguished for their Flowers.
Native Shrubs or Trees distinguished for their beautiful Fruit.
A list of native Trees and Shrubs distinguished for their showy or brilliant colored Bark.

Native Climbing Plants.
Native Plants which are very light Colored.
A list of Small Evergreens.
Bronze Evergreens.
Native Bog and Marsh plants which are Promising for Cultivation.
Plants suitable for winter Bouquets.
Native Aquatic Plants most worthy of Cultivation.
A list of native Ferns promising for Cultivation.
The Procession of Flowers.
The best Kinds of Timber for Firewood.
The most durable Kinds of Timber for Post or Sills.
Favorite Kinds of Timber for the Cabinet Maker.
Timber for farm Implements.
Valuable Timber for large Boats.
Kinds of timber most employed for Boxes, Baskets and Barrels.
Timber for Paper Pulp.
Trees for Sugar.
Trees and Shrubs best suited for Screens or Wind-breaks.
Some of our wild fruits and nuts, with suggestions concerning their improvement.
Native plants for the Protection of Hillsides, Embankments and drifting Sands.
Plants for Carp Ponds.
Native tree-like or large Shrubs.
List of smaller Shrubs.
List of Rare or Local Plants.
List of Plants introduced from Europe and becoming Naturalized.
Parasitic Fungi.
Flowering Parasites and Saprophytes destitute of green leaves.
List of Michigan Plants which are admitted to the United States Pharmacopœia.
List of medicinal Plants not officinal.

As mentioned in both editions of the Flora above referred to, so in this, the third edition, much pains has been taken to examine authentic specimens which are preserved in some herbarium. For thirty years, till he resigned his position at the Agricultural College in 1902, Professor C. F. Wheeler was a most diligent collector of plants in the State. He kept full notes, not only of his findings but sought specimens and notes from many others.

In 1888, Professor L. H. Bailey, C. F. Wheeler and the author accompanied by two students spent two weeks in collecting on a journey across the State from Harrisville in Alcona county to Frankfort in Benzie county.

In 1892, Professor Wheeler spent several weeks in the southeastern and in the southwestern counties and in the Upper Peninsula making collections for the exposition held in Chicago. In 1895, some weeks were spent collecting in Alpena and vicinity, and later he and B. O. Longyear collected in Ingham, Washtenaw, and Jackson counties. In the summer of 1900 Professor Wheeler spent about six weeks collecting at Chatham and vicinity in the Upper Peninsula.

Portions of every year since 1890 were occupied by Professor Wheeler in making great numbers of short excursions in behalf of the herbarium of the Agricultural College. During these years and previously, the author collected considerable in the counties of Iosco, Clare, Crawford, Grand Traverse, Lake, Muskegon, Calhoun, Eaton, Lenawee, Clinton, Ingham. More particularly since 1890, numerous collections made by others have been sent to the Agricultural College for identification and for preservation in the herbarium.

Notably among these collectors must be mentioned Miss Emma J. Cole

and H. C. Skeels of Grand Rapids; C. D. McLouth of Muskegon; G. H. Hicks of Grayling, Owosso and the Agricultural College; C. K. Dodge of Port Huron; George M. Bradford of Bay City; W. K. Brotherton of Oakland; Geo. W. Davis of Tekonsha; J. W. Stacy of Clarksville. Collections have been received, by gift or purchase, from Prof. C. A. Davis formerly of Alma, now of the University; of O. A. Farwell formerly of Keweenaw county, of Ypsilanti, and later of Detroit; and Rev. Francis Daniels formerly of Alto, Kent county, Manistee and Sturgis; W. S. Cooper of Alma.

After all has been said and done, the study of the flora of the state at best can only be considered as fairly begun. By far the greater areas have not yet been seen by any systematic botanist and very few regions have been visited by one who is an expert in some one or more of the more difficult families.

What species flourished in large areas will never be fully known, since man has cut off, burned over and plowed under tens of thousands of acres of the virgin wilderness! Swamps, marshes and lakes have been drained and the land occupied by farm crops. Many native plants are rapidly shifting from one place to another.

Chiefly through the agency of man, great numbers of weeds and other plants have been introduced from other states and from foreign countries and each has begun a vigorous warfare for all the room it can get.

The sequence of natural families in former Michigan Floras followed *Gray's Manual* which is essentially that of Auguste Pyrame De Candolle. Most of the reasons given for that arrangement have long since been considered untenable. In the Flora, I have followed *Britton's Manual of the Flora of the Northern States and Canada,* published in April, 1901. In this work the sequence of families is very nearly the same as that of Engler and Prantl, which is considered the most philosophical yet presented.

Some of the guiding principles for the system of Engler and Prantl, as they are stated by Britton and Brown's Flora, are as follows:

The more simple forms are, in general, distinguished from the more complex. (1) by fewer organs or parts; (2) by the less perfect adaptation of the organs to the purposes they subserve; (3) by the relative degree of development of the more important organs; (4) by the lesser degree of differentiation of the plant-body or of its organs; (5) by considerations of antiquity, as indicated by the geological record; (6) by a consideration of the phenomena of embryogeny. Thus, the Pteridophyta, which do not produce seeds and which appear on the earth in Silurian time, are simpler than the Spermatophyta; the Gymnospermæ in which the ovules are borne on the face of a scale, and which are known from the Devonian period onward, are simpler than the Angiospermæ, whose ovules are borne in a closed cavity, and which are unknown before the Jurassic.

In the Angiospermæ the similar types are those whose floral structure is nearest the structure of the branch or stem from which the flower has been metamorphosed, that is to say, in which the parts of the flower (modified leaves) are more nearly separate or distinct from each other, the leaves of any stem or branch being normally separated, while those are the most complex whose floral parts are most united.

The names of genera and species are the same as those used in *Britton's Manual* and where these differ from those in the sixth edition of

Gray's Manual, the latter are also inserted in the text. The species of each genus are arranged in alphabetical order. To economize space a considerable number of sections of the Flora last prepared have been omitted or much abbreviated.

In the preparation of this Flora thanks are due to Professor C. F. Wheeler, O. A. Farwell, Prof. C. A. Davis, C. K. Dodge, C. D. McLouth, G. M. Bradford, J. B. Dandeno.

W. J. BEAL.

Agricultural College, Mich., Dec. 1, 1904.

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HERBARIA CONSULTED.

The following Herbaria have been examined:

The Herbarium of the State Agricultural College is fortunate in possessing the collection of Dr. D. Cooley, an excellent botanist who lived many years in Washington, Macomb county. He was a valued correspondent of Dr. Gray, Dr. Torrey, W. S. Sullivant and other botanists of the early part of this century.

The Herbarium of Dr. D. Clark, of Flint, Mich., has lately become the property of the State Agricultural College. This collection contains sets of Bebbs' Willows, Olney's Carices and many specimens from the earlier American collectors, besides valuable collections of Michigan plants.

The large collection of Prof. C. F. Wheeler, which was destroyed by the burning of the Botanical Laboratory on the 23d of March, 1890.

Prof. V. M. Spalding kindly permitted us to examine the University Herbarium at Ann Arbor, in which are deposited the collections of Dr. Douglass Houghton, 1838; Miss Mary H. Clark, Miss E. C. Almendinger, Prof. M. W. Harrington, Prof. N. H. Winchell, Geo. L. Ames, M. D., F. E. Wood and others.

The collection of plants belonging to the Kent Scientific Institute at Grand Rapids under the charge of Mr. George D. Sones.

The collection of O. J. Stilwell, which belongs now to Prof. C. A. Davis of University of Michigan; also Prof. Davis' collection.

The collection of G. H. Hicks, of the Agricultural College, made in Northern and Central Michigan.

The collection of G. F. Comstock, made in Lenawee County, 1845-'50, now the property of Dr. W. J. Beal.

The collection of Dr. W. J. Beal, 1860-1870, now the property of the Michigan Agricultural College.

LOCAL LISTS CONSULTED.

To the following persons we are indebted for lists of the plants growing in their several localities:

Farwell, O. A., for full list of plants of the Keweenaw peninsula, Ypsilanti and Detroit, with copious notes and many specimens.

Beardslee, Prof. H. C., of the University School, Cleveland, O., and Kofoid, Prof. Chas. A., Leland Stanford Jr. University, for a very complete list of the plants of Cheboygan County, Mich., observed by them during the summer of 1890, with full notes and many specimens.

Dodge, C. K., for a collection of the plants growing in the vicinity of Port Huron, with many notes on variation and distribution.

Dewey, L. H., for a list of the plants in the vicinity of Tecumseh, Mich.

Hull, Prof. W., for notes and specimens from Albion and vicinity.

Orth, S. P., for list of plants in the vicinity of Imlay City.

Mosely, E. H., for a list of plants observed near Union City.

Foerste, A. F., for a list of plants observed in the eastern part of St. Clair county.

Mitchell, Prof. I. N., for a list of plants collected in various parts of the State.

St. John, Prof. C. E., for a list of plants collected in Mason county and in the southeastern portion of the State.

Stacey, I. W., for a list of plants collected at Clarksville, Ionia county.

Daniels, F. P., for a list of plants collected at Manistee and Sturgis.

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TOPOGRAPHY.

Michigan is peculiarly situated within the waters of the great lakes, N. latitude 41°45′ to 48°20′; W. longitude 82°25′ to 90°34′. It is divided into two parts, called the Upper and Lower Peninsulas. The greatest length of the northern portion from east to west is 318 miles, width 30 to

164 miles, forming about two-fifths of the State. The greatest length of the southern portion from north to south is 277 miles and its extreme width is 259 miles. The total area is 58,915 square miles, with a coast of over 1,600 miles.

The general elevation of the Upper Peninsula is 400 to 1,100 feet above Lake Superior, and that of the Lower Peninsula is 400 to 600 feet above the level of Lakes Michigan and Huron.

The two parts of the State present a striking contrast in many respects. The Upper Peninsula may be divided into two sections east and west of a line drawn through Marquette which present very marked surface and geological characteristics. The eastern portion slopes northward from its southern border to a watershed and thence falls rapidly to the shores of Lake Superior. This plateau contains many lakes and marshes, also fine forests of pine intermixed with groves of hardwood.

The western part is rugged and hilly, some of the hills rising 1,000 to 1,200 feet. In the extreme northwest are ranges which form the copper region; the central range extends from Keweenaw Point across to the Wisconsin line; on either side are the Porcupine mountains and the copper range proper.

South and east of the copper range lies the iron range of Marquette and Iron counties. The eastern portion of this peninsula is underlaid with stratified rocks belonging to the Silurian period, while the western part is occupied by the copper bearing rocks and those of the Huronian period. Glacial drift covers deeply a large portion of both the eastern and western sections.

The Lower Peninsula is generally level or rolling, sloping up in its northern portion to a central ridge or watershed which extends nearly northeast and southwest, the highest part of which, in Otsego county, is 1,100 feet above the lake level.

The shores along the west side of this peninsula are generally bold bluffs which are constantly wearing away, while on the Huron shore they are low and extending by additions of earth cast up by the waves.

The rivers are small but their number is great, and these, with the 5,000 lakes scattered along the watersheds of the State abundantly water all parts of it.

Dr. C. Rominger, a former State Geologist, writes of the geology of the Lower Peninsula as follows: "It forms the center-point of an oceanic bay which seems to have existed without any important alteration in its limits, from the beginning of the Silurian period to the end of the Carboniferous time. We find within the space supposed to have been the bay an uninterrupted series of marine deposits, following each other in the greatest regularity of superposition, which represent all the known formations deposited on this continent from the Silurian period on to the coal formation." The entire surface of the peninsula is covered deeply with glacial drift, consisting of sand, gravels and clays variously intermixed.

The topographical outlines of the Lower Peninsula are due to the joint action of moving ice and flowing water during and following the glacial period.

Beginning in Presque Isle county the lateral moraine of the Huron glacier passes southwest near the line between Montmorency and Alpena counties, thence south by west through Oscoda, Roscommon and Clare, meeting in Mecosta county, the east lateral moraine of Lake Michigan. These join and pass in a southwest direction through Kent, Barry, Kala-

mazoo and St. Joseph counties. The Saginaw bay branch of the Huron glacier unites with the Huron glacier proper, and forms a lateral moraine beginning in Huron county, passing through Sanilac, Lapeer, Oakland, Livingston and portions of Jackson, Washtenaw and Hillsdale counties. This peninsula is divided by these moraines into certain more or less clearly marked floral regions.

CLIMATE AND DISTRIBUTION.

"The sinuosities of the several isothermal lines will demonstrate at a glance the peculiar character of the climate of Michigan, and the fact that both in summer and winter, it is better adapted to the interests of agriculture and horticulture, and probably also to the comfort and health of its citizens, than the climate of any other northwestern state. The marked peculiarity of the climate of Michigan in these respects is attributable to the influence of the great lakes by which the state is nearly surrounded. It has long been known that considerable bodies of water exert a local influence in modifying climate and especially in averting frosts, but it has never been expected that Lake Michigan, for instance, impresses upon the climatic character of a broad region an influence truly comparable with that exerted by the great ocean."—ALEXANDER WINCHELL.

The following general notes on Climate and Distribution are from the preface to the first edition by E. F. Smith:

"The influence of climate on vegetation may be summed up in a few words. The climate of the Lower Peninsula is not as severe as that of the Upper, nor so even, but is subject to frequent, sudden, and extreme changes of temperature—as great a variation during the winter season as 53° Fahr. in less than 24 hours having been recorded. Such rapid changes more or less affect vegetation, especially the tender branches of cultivated trees, which are sometimes seriously injured. In one or two instances a like effect on our forest trees has been noticed. The annual range of temperature is about 116°, and the annual mean 46°. Of rainfall, including what falls in form of snow, we have, yearly, about thirty inches. Our snowfall is much less, for the same latitude, than that of New York and New England. In the center of the peninsula, we seldom have more than a few inches at a time.

"The proximity of the Great Lakes exerts a marked influence in equalizing the temperature and the effects are marked upon our flora.

"Trees, like *Liriodendron Tulipifera, Asimina triloba, Cercis Canadensis, Gleditsia triacanthos, Cornus florida, Nyssa multiflora,* and *Morus rubra,* which belong to Ohio and Central Illinois, have crept northward, favored by the mild influence of the lake winds, through the central and western part of the Lower Peninsula, often beyond the middle, and the same is true of smaller and less noticeable plants.

"As might be expected from the uniform surface of the peninsula, the flora is much alike throughout. Probably three-fourths of our species are common to all sections, though by no means equally distributed; some being very abundant in one district and rare in another at no great distance. In most cases such change is due to soil rather than to difference in elevation, temperature, or atmospheric moisture.

"The Lower Peninsula is covered with a deep drift of alternating sands, clays, and gravels, and the flora of any section depends chiefly on which of these happens to lie uppermost. With reference to its flora, the penin-

sula may roughly be divided into two great divisions—the hardwood and the softwood lands; one representing the Appalachian flora, and the other, the Canadian.

"The hardwood country lies south of latitude 43°, and consists of very fertile sand, clay, or loam, mostly cleared of the original forest, and largely cultivated.

"The sandy or stony drift of many river valleys in this section supports a heavy growth of oak, frequently interspersed with walnut and hickory, while the margins of the streams, and the neighboring swamps, abound in soft maples, swamp and chestnut oak, white and black ash, elm, hackberry, sycamore, butternut, and similar trees. Willows, dogwoods, viburnums, and buttonbush, are common shrubs in the swamps; and hazel, hawthorn, wild cherry and plum, June berry, witch-hazel, etc., are abundant on the dryer ground.

"On the uplands, and away from streams, clay, loam, and a peculiar black muck soil supersede the sands and gravels of the valleys. The prevailing timber here is beech and maple and oak forest in about equal proportions. Beech and maple generally grow together, forming magnificent forests of great extent. The best wheat farms are usually found on uplands near streams, where the oak timber gradually shades into beech and maple. Plains of fertile sand covered with a low, or scattering growth of oak (oak openings) are frequent, and always very desirable for farming purposes.

"Marshes densely covered with tamarack are common in this part of the State, and nourish in their thick shade such plants as *Drosera rotundifolia, Sarracenia purpurea, Rhus venenata, Ribes rubrum, Chiogenes hispidula, Salix candida, Smilacina trifolia, Pogonia ophioglossoides* and *Calopogon pulchellus.* Arbor-vitæ, red cedar and black spruce are comparatively rare.

"A similar tract of soil and timber occurs in the upper end of the peninsula, north of a line drawn from Thunder bay west to the head of Grand Traverse bay. This is commonly known as the "Traverse region," and has a flora much like that we have just described, with the exception that some of the southern species disappear, and northern ones begin to take their place, or if found growing further south, here first become frequent. Deep forests of hemlock and yellow birch (*B. lutea*) mixed with a fine, tall growth of striped maple (*A. Pennsylvanicum*) are frequent, having underneath a tangled growth of *Taxus baccata,* var. *Canadensis,* and under all a carpet of *Lycopodium annotinum.* Alternating with these are sandy plains covered with a dense growth of *Vacciniums,* yielding a great abundance of fruit. Sugar maples and basswood are also abundant in this region, and reach an immense size. In fact, it would be difficult to find finer groves of maple in any part of the State.

"The pine country proper lies between the two tracts we have described, and embraces about 15,000 square miles. It is composed largely of sand hills and plains, either scantily furnished with vegetation, or densely covered with pine forest. Argillaceous tracts wooded with beech and maple also occur, like oases in a desert; and swamps abound, with the usual lowland timber. Forests of hemlock spruce are frequent, and there are occasional ridges of oak. Birch (*B. lutea*) also begins to be a common forest tree, and attains a large size. The usual timber of the barrens is Jack Pine (*P. Banksiana*). Climatic and other influences have combined to produce groves composed entirely of this species of large size and of great

beauty, for, instead of being 'a straggling shrub, or low tree' (Gray), it rises, often 50-60 feet, straight and symmetrical. All through this region *Pinus Strobus* is the prevailing species and furnishes most of the lumber, but *P. resinosa* is frequent as far south as Clare county, and occurs sparingly in the northern part of Isabella county, which appears to be its southern limit.

"Such is the general character of the sylva down to about latitude 43°, but in the western part of the State, owing perhaps to moister climate, or to favorable soil, hemlock spruce is more abundant, and reaches much farther south, nearly or quite to the Indiana line, and the same is true of white pine.

"The flora of the deep pine woods is interesting, though rather monotonous. Very little undergrowth is found, and their gloomy recesses nourish only such plants as love thick shade. Here the club-mosses (*Lycopodiums*) find a congenial home, and flourish luxuriantly, while *Clintonia borealis* covers the ground. The great round-leaved orchid (*Habenaria orbiculata*), with its tall, greenish spike and twin leaves close to the earth, is also frequent and striking. We shall also meet *Mitchella repens, Maianthemum Canadense, Trillium grandiflorum,* perhaps, and a few ferns, particularly *Asplenium Filix-fœmina* and *Phegopteris Dryopteris.* Other species occur, of course, but not so abundantly. In more open places, and on ridges, we meet *Rhus aromatica* and *Comptonia* along with wintergreen (*Gaultheria*) and trailing arbutus (*Epigæa*), and are often fortunate enough to find the wax-white, fragrant flower of *Moneses uniflora,* or *Polygala paucifolia,* hiding its shining leaves under a wealth of showy pink blossoms.

"The floral treasures of the pine region lie, however, in its swamps and lake borders rather than in the deep woods. Therein grows *Linnæa borealis* in all its delicate beauty, carpeting the ground, and close at hand, the odd, brown-purple flower of *Cypripèdium acaule* and the small yellow blossom of its water-loving relative *C. parviflorum.* In such swamps, or within a stone's throw of them, may be found many other plants of equal interest, such as *Medeola Virginica, Ledum latifolium, Andromeda Polifolia, Kalmia glauca, Lonicera oblongifolia, Cardamine pratensis, Gerardia aspera, Mitella nuda, Eriophorum vaginatum, etc.* On lake margins we shall find *Lysimachia* and the blue *Pontederia* and more rarely, *Nesæa* and *Eleocharis quadrangulata.* The lake itself, most likely, will be full of *Nymphaea, Nuphar, Utricularias,* and a world of *Potamogetons* and similar water weeds. Shrubby *Vacciniums* line the bluffs, and here and there gleam the white trunks of paper birches against the dark background of pines.

"In the thick-pine country, where the lumberman's ax has let in the sunlight, new plants spring up freely. Here, *Prunus Pennsylvanica* and poplars are frequent, and the blackberry is omnipresent. *Aralia hispida* and *Physalis lanceolata* are also peculiar to such land, and in August *Gnaphalium decurrens* may be seen whitening thousands of acres.

"One seldom beholds a drearier sight than a dead and deserted lumber region. The valuable trees were all felled years ago, and the lumberman moved on to fresh spoils, leaving behind an inextricably confused mass of tree tops, broken logs, and uprooted trunks. Blackberry canes spring up everywhere, forming a tangled thicket, and a few scattering poplars, birches, and cherries serve for arboreal life, above which tower the dead pines, bleached in the weather and blackened by fire, destitute of

limbs, and looking at a distance not unlike the masts of some great harbor. Thousands of such acres, repellant alike to botanist and settler, can be seen in any of our northern counties.

"In certain districts considerable beech is found associated with the pine. The soil of such tracts is usually of better quality, and can be rendered productive without much labor. It may be noted that in such cases the pine also grows thriftier and makes better lumber."

FLORA OF THE JACK-PINE PLAINS.

The plants of this region are all found in one or more of the regions previously enumerated.

The soil of these plains is mainly sand of considerable depth which dries out quickly after a rain, and is then especially liable to be burned over, the burning often destroying every living plant above the surface of the soil. In this way, by repeated burning, much of the vegetable matter is removed, leaving the surface soil thin.

The following seventy species of plants are almost certain to be found in considerable quantity on any extended area of Jack-pine plains:

a. THOSE MOST COMMON.

Amelanchier Botryapium (L. f.) DC. Shad-bush.
(*Amelanchier Canadensis* var. *oblongifolia* T. & G.)
Andropogon furcatus Muhl. Finger, or Beard-grass.
Andropogon scoparius Michx. Beard-grass.
Arctostaphylos Uva-Ursi (L.) Spreng. Bearberry.
Aster lævis L. Smooth Aster.
Carex Pennsylvanica Lam. Pennsylvania Sedge.
Comptonia peregrina (L.) Coulter.
(*Myrica asplenifolia* L.)
Danthonia spicata (L.) Beauv. Wild Oat-grass.
Epigæa repens L. Trailing Arbutus.
Gaultheria procumbens L. Wintergreen.
Leptilon Canadense (L.) Britton. Horse-weed.
(*Erigeron Canadensis* L.)
Oryzopsis juncea (Michx.) B. S. P. Mountain Rice.
(*Oryzopsis Canadensis* Torr.)
Pinus divaricata (Ait.) Gord. Gray Pine. Jack Pine.
(*Pinus Banksiana* Lambert.)
Populus tremuloides Michx. Aspen.
Prunus Pennsylvanica L. f. Wild Red, or Pin Cherry.
Prunus pumila L. Sand Cherry.
Prunus Virginiana L. Choke-Cherry.
Pteridium aquilinum (L.) Kuntze. Eagle Fern.
(*Pteris aquilina* L.)
Quercus coccinea Wang. Scarlet Oak.
Quercus velutina Lam. Black Oak.
(*Quercus tinctoria* Bartram.)
Rumex Acetosella L. Sheep Sorrel.
Salix humilis Marsh. Low willow.
Solidago nemoralis Ait. Golden Rod.
Vaccinium Canadense Richards. Low Blueberry.
Vaccinium Pennsylvanicum Lam. Dwarf Blueberry.
Vaccinium vacillans Kalm. Low Blueberry.

b. THOSE LESS FREQUENT.

Adopogon Virginicum (L.) Kuntze. Dwarf Dandelion. Virginia Goatsbeard
(*Krigia amplexicaulis* Nutt.)
Agrostis hyemalis (Walt.) B. S. P.
(*Agrostis scabra* Willd.) Hair-Grass.

Antennaria plantaginifolia (L.) Richards. Plaintain-leaved Everlasting.
Apocynum androsæmifolium L. Dogbane.
Aralia hispida Vent. Bristly Sarsaparilla.
Campanula rotundifolia L. Bluebell. Harebell.
Carduus odoratus (Muhl.) Porter.
(*Cnicus pumilus* Torr.)
Ceanothus Americanus L. New Jersey Tea.
Comandra umbellata (L.) Nutt. Bastard Toad-flax.
Convolvulus spithamæus L. Low Bindweed.
Diervilla Diervilla (L.) MacM. Bush Honeysuckle.
(*Diervilla trifida* Moench.
Erigeron ramosus (Walt.) B. S. P. Daisy Fleabane.
(*Erigeron strigosus* Muhl.)
Festuca ovina L. Sheep's Fescue.
Fragaria Virginiana Duchesne. Strawberry.
(*Fragaria Virginiana Illinoensis* A. Gray.)
Gaylussacia resinosa (Ait.) T. & G. Black Huckleberry.
Gnaphalium decurrens Ives. Everlasting.
Helianthemum Canadense (L.) Michx. Frost-wort.
Helianthus divaricatus L. Wild Sunflower.
Helianthus occidentalis Riddell. Wild Sunflower.
Hieracium venosum L. Rattlesnake-weed.
Houstonia longifolia Gaertn. Houstonia.
(*Houstonia purpurea longifolia* A. Gray.)
Koeleria cristata (L.) Pers. Koeleria.
Lacinaria cylindracea (Michx.) Kuntze. Blazing Star.
(*Liatris cylindracea* Michx.)
Lithospermum Gmelini (Michx.) A. S. Hitchcock. Hairy Puccoon.
(*Lithospermum hirtum* Lehm.)
Lycopodium complanatum L. Ground-pine.
Melampyrum lineare Lam. Cow-wheat.
(*Melampyrum Americanum* Michx.)
Monarda fistulosa L. Wild Bergamot.
Onagra biennis (L.) Scop. Evening primrose.
(*Œnothera biennis* L.)
Panicum depauperatum Muhl. Panic-Grass.
Panicum dichotomum L. Panic-Grass.
Pinus resinosa Ait. Norway or Red Pine.
Pinus Strobus L. White Pine.
Polygala polygama Walt. Pink polygala.
Populus grandidentata Michx. Large-toothed Aspen.
Potentilla Canadensis L. Five-finger. Cinque-foil.
Quercus alba L. White Oak.
Rubus Canadensis L. Dewberry.
Rubus hispidus L. Dewberry.
Rudbeckia hirta L. Cone-flower.
Sibbaldiopsis tridentatata (Soland.) Rydb. Three-toothed Cinque-foil.
(*Potentilla tridentata* Ait.)
Solidago juncea Ait. Golden Rod.
Unifolium Canadense (Desf.) Greene.
(*Maianthemum Canadense* Desf.)
Viola arenaria DC. Sand Violet.
(*Viola canina puberula* S. Wats.)
Viola pedata L. Bird-foot Violet.

The above list consists of representatives of thirty families, of fifty-four genera, and of seventy species. The families of plants best represented on the plains are the *Rosaceæ* by six species, *Compositæ* by thirteen species, *Gramineæ* by nine species, *Vacciniaceæ* by four.

The following large and prominent families of the State are not represented in the list given above: *Ranunculaceæ*, *Cruciferæ*, *Caryophyllaceæ*, *Saxifragaceæ*, *Umbelliferæ*, *Orchidaceæ*.

Most remarkable of all is the absence of any *Papilionaceæ* though the family is second in size only to the *Compositæ*. The *Papilionaceæ* is represented in the State by 43 native species and varieties.

The number of biennials given in this list is remarkably small, only two, and there are no annuals in it. Sixty-eight out of seventy are perennials and most persistent plants well adapted by long, deep roots and root-stocks to live in poor soil which is subject to severe droughts. Most of them are admirably adapted to survival after a severe fire has burned over the ground and killed the tops of the plants.

PLANTS INDICATING A FERTILE SOIL.

Acer Saccharum Marsh. Sugar Maple, when the wood is solid and of fine quality.
(*Acer saccharinum* Wang.)
Acer nigrum Michx. Black sugar maple.
(*Acer saccharinum nigrum* Torr. & Gray.)
Adiantum pedatum L. Maidenhair Fern.
Angelica villosa (Walt.) B. S. P. Angelica.
(*Angelica hirsuta* Muhl.)
Apios Apios (L.) Mac M. Ground-nut.
(*Apios tuberosa* Moench.)
Arisæma triphyllum (L.) Torr. Indian Turnip.
Asplenium angustifolium Michx. Spleenwort.
Asplenium acrostichoides Sw. Spleenwort.
(*Asplenium thelypteroides* Michx.)
Cassia Marylandica L. Wild Senna.
Collinsonia Canadensis L. Rich-weed. Stone-root.
Crataegus tomentosa L. Hawthorn.
Dentaria diphylla Michx. Toothwort. Pepper-root.
Dentaria laciniata Muhl. Toothwort. Pepper-root.
Bicuculla Canadensis (Goldie) Millsp. Squirrel Corn.
(*Dicentra Canadensis* DC.)
Bicuculla Cucullara (L.) Millsp. Dutchman's Breeches.
(*Dicentra Cucullaria* DC.)
Fraxinus Americana L. White Ash.
Fraxinus quadrangulata Michx. Blue Ash.
Hydrastis Canadensis L. Golden Seal.
Hydrophyllum Canadense L. Waterleaf.
Hydrophyllum Virginicum L. Waterleaf.
Juglans cinerea L. Butternut.
Juglans nigra L. Black Walnut.
Menispermum Canadense L. Moonseed.
Orchis spectabilis L. Showy Orchis.
Podophyllum peltatum L. May-Apple. Mandrake.
Quercus alba L. White Oak. When well grown.
Quercus macrocarpa Michx. Bur-Oak.
Ribes Cynosbati L. Prickly Gooseberry.
Rubus occidentalis L. Black Raspberry.
Scrophularia Marylandica L. Figwort.
(*Scrophularia nodosa Marylandica* A. Gray.)
Taraxacum Taraxacum (L.) Karst. Dandelion.
(*Taraxacum officinale* Weber.)
Tilia Americana L. Basswood.
Ulmus Americana L. American Elm.
Ulmus racemosa Thomas. Rock Elm.
Uvularia grandiflora J. E. Smith. Bellwort.
Verbena hastata L. Blue Vervain.

When well grown and of good size, several other trees are indications of good soil.

PLANTS PECULIAR TO THE PRAIRIES.

The following plants are peculiar to the prairie region of the southwestern portion of the State:

Amorpha canescens Pursh. Lead-Plant.
Asclepias verticillata L. Milkweed.
Aster sericeus Vent. Aster.
Atheropogon curtipendulus (Michx.) Fourn.
(*Bouteloua curtipendula* (Michx.) Torr.)
Baptisia leucantha Torr. & Gray. False Indigo.
Brauneria purpurea (L.) Britton. Cone-Flower.
(*Echinacea purpurea* Moench.)
Coreopsis palmata Nutt.
Helianthus scaberrimus Ell. Sunflower.
(*Helianthus rigidus* Desf.)
Phlox bifida Beck. Phlox.
Silphium integrifolium Michx. Rosin-weed.
Silphium laciniatum L. Compass-plant.
Silphium perfoliatum L. Cup-plant.

OVERLAPPING OF NORTHERN AND SOUTHERN SPECIES IN THE GRAND RIVER VALLEY.

NORTHERN SPECIES.

Carex Magellanica Lam. Sedge.
Carex pauciflora Lightf. Sedge.
Carex tenuiflora Wahl. Sedge.
Dracocephalum parviflorum Nutt. Dragon-head.
Eriophorum vaginatum L. Cotton-grass.
Lonicera oblongifolia (Goldie) Hook. Swamp Fly-Honeysuckle.
Mimulus Jamesii T. & G. Monkey-flower.
Primula Mistassinica Michx. Primrose.
Symphoricarpos pauciflorus (Robbins) Britton. Snowberry.
(*Symphoricarpos racemosus pauciflorus* Robbins.)
Taxus Canadensis Willd. American Yew. Ground Hemlock.

SOUTHERN SPECIES.

Asimina triloba (L.) Dunal. Papaw.
Bidens trichosperma tenuiloba (A. Gray) Britton. Tick-seed. Sunflower.
(*Coreopsis trichosperma* var. *tenuiloba* A. Gray.)
Cassia Marylandica L. Wild Senna.
Cercis Canadensis L. Red-bud. Judas-tree.
Chaerophyllum procumbens (L.) Crantz.
Collinsia verna Nutt. Blue-eyed Mary.
Eleocharis interstincta (Vahl.) R. & S. Spike-rush.
(*Eleocharis equisetoides* Torr.)
Eleocharis mutata (L.) R. & S. Spike-rush.
(*Eleocharis quadrangulata* R. & S.)
Eleocharis olivacea Torr. Spike-rush.
Eleocharis Robbinsii Oakes. Spike-rush.
Eleocharis rostellata Torr. Spike-rush.
Erigenia bulbosa (Michx.) Nutt. Harbinger of Spring.
Gymnocladus dioica (L.) Koch. Ky. Coffee-tree.
(*Gymnocladus Canadensis* Lam.)
Hicoria laciniosa (Michx. f.) Sarg. King-nut.
(*Carya sulcata* Nutt.)
Hemicarpha micrantha (Vahl.) Britton.
(*Hemicarpha subsquarrosa* Nees.)
Liriodendron Tulipifera L. White-wood. Tulip-tree.
Meibomia Marylandica (L.) Kuntze. Tick-Trefoil.
(*Desmodium Marilandicum* Boot.)
Morus rubra L. Red Mulberry.

Silphium terebinthinaceum Jacq. Prairie Dock.
Tradescantia Virginica L. Common Spiderwort.
Utricularia resupinata B. D. Greene. Bladderwort.

COMPARISON OF THE FLORA OF THE EASTERN AND THE WESTERN SIDES OF THE STATE IN THE LATITUDE OF 44°40′.

On the east side, the latitude in question is near Harrisville in Alcona county. On the west side it is near Frankfort in Benzie county.

It has long been known that the climate of the west shore where the wind sweeps across Lake Michigan was milder in winter, and throughout the year less variable than it is on the east side of the State. So far as observed, the plants of the State which are only found in the vicinity of the great lakes are more abundant in individuals on the west shore.

A. NORTHERN PLANTS FOUND ON THE EAST SIDE OF THE STATE AND NOT ON THE WEST.

Botrychium Lunaria (L.) Swartz. Moonwort.
Botrychium simplex Hitchcock. Moonwort.
Carex capillaris L. Sedge.
Carex durifolia Bailey. Back's Sedge.
(*Carex Backii* Boott.)
Carex Houghtonii Torr. Sedge.
Dracocephalum parviflorum Nutt. Dragon-head.
Kalmia angustifolia L. Sheep Laurel. Lambkill.
Kalmia glauca Ait. Swamp Laurel. Pale Laurel.
Picea Canadensis (Mill) B. S. P. White Spruce.
(*Picea alba* Link.)
Ribes lacustre (Pers.) Poir. Swamp Gooseberry.
Sparganium simplex Huds.

B. SOUTHERN PLANTS FOUND ON THE WEST SIDE OF THE STATE AND NOT ON THE EAST.

Adiantum pedatum L. Maiden Hair Fern.
Acer saccharinum L. Silver Maple.
(*Acer dasycarpum* Ehrh.)
Rubus occidentalis L. Black Raspberry.
Sambucus Canadensis L. Common Elder.
Sassafras Sassafras (L.) Karst.
(*Sassafras officinale* Nees.)
Ulmus fulva Michx. Red Elm.
Ulmus racemosa Thomas. Rock Elm.

This list is doubtless incomplete, but so far as it goes it sustains the prevailing notion that the west side of the State has the milder climate. We might be able to see why silver maple, sassafras, black raspberry, red elm and rock elm thrive on the west shore and not on the east, but we are unable to see why the northern plants found on the east shore should not be found on the west shore. Perhaps there is some other reason than the difference of climate of the present day.

PLANTS SUPPOSED TO HAVE IMMIGRATED FROM THE NORTHEAST.

Calypso bulbosa (L.) Oakes.
(*Calypso borealis* Salisb.)
Clintonia borealis (Ait.) Raf.
Equisetum littorale Kuehl.
Eriocaulon septangulare Withering. Pipewort.
Gyrostachys stricta Rydb. Hooded Ladies' Tresses.
(*Gyrostachys Romanzoffiana* (Cham.) MacM.)
Selaginella selaginoides (L.) Link.
(*Selaginella spinosa* Beauv.)

Trillium erectum L. Wake Robin.
Trillium undulatum Willd. Painted Wake-Robin.
(*Trillium erythrocarpum* Michx.)

PLANTS SUPPOSED TO HAVE IMMIGRATED FROM THE NORTH AND WEST.

Adenocaulon bicolor Hook.
Anemone parviflora Michx. Anemone.
Artemisia gnaphalodes Nutt. Mugwort.
(*Artemisia Ludoviciana gnaphalodes* T. & G.)
Brauneria pallida (Nutt.) Britton. Purple Cone-flower.
(*Echinacea angustifolia* DC.)
Bromus breviaristatus (Hook.) Buckl. Brome Grass.
Castilleja acuminata (Pursh) Spreng. Painted-cup.
(*Castilleja pallida septentrionalis* A. Gray.)
Drosera linearis Goldie. Sundew.
Euphorbia serpyllifolia Pers. Spurge.
Iva xanthiifolia (Fresen.) Nutt. Marsh Elder.
Lonicera involucrata (Richards) Banks. Honeysuckle.
Mertensia paniculata (Ait.) G. Don. Lungwort.
Mimulus Jamesii T. & G. Monkey-flower.
Mimulus moschatus Dougl. Musk-flower.
Panicularia pallida (Torr.) Kuntze.
(*Glyceria pallida* Trin.)
Roripa obtusa (Nutt.) Britton.
(*Nasturtium obtusum* Nutt.)
Parnassia palustris L. Grass of Parnassus.
Parnassia parviflora DC. Grass of Parnassus.
Phacelia Franklinii (R. Br.) Gray.
Polygonum lapathifolium incanum (Schmidt) Koch. Knotweed.
Potentilla Robbinsiana Oakes.
(*Potentilla frigida* A. Gray.)
Ranunculus reptans intermedius (Hook.) T. & G. Creeping Spearwort.
(*Ranunculus Flammula intermedius* Hook.)
Rosa Engelmanni Watson. Rose.
Rosa Sayi Schwein. Rose.
Rumex salicifolius Weinm. White Dock.
Sorbus sambucifolia (C. & S.) Roem. Western Mountain Ash.
(*Pyrus sambucifolia* Cham. & Schlecht.)
Symphoricarpos occidentalis Hook. Wolfberry.

TREES OF MICHIGAN COMPARED WITH THOSE OF EUROPE.

Michigan is very rich in trees. If we have counted correctly there are 90 species of indigenous trees and three exotics which have escaped from cultivation.

To comprehend the relative importance of our trees, let us glance at the forests of Great Britain. Great Britain and Ireland contain 121,260 square miles of land, Michigan 60,000, a little less than one-half as much as Great Britain. She has one species of basswood not so good as ours; one maple not over twenty feet high; one cherry from ten to twenty feet high; one small ash, two elms, two poplars, one beech, which grows very large but not very high; one small white birch, one species of pine, by no means a match for our white pine; a species of oak which sometimes grows to a great size.

Great Britain has about ten species of trees native to her soil. Michigan, with half the territory, has eighty-five species. Great Britain has no whitewood, no white or red cedar, no walnuts or hickories. Michigan has six species of maple of tree size, a basswood, a whitewood, honey locust, Kentucky coffee tree, three cherries, a pepperidge, five species of ash, a

sassafras, three elms, a hackberry, a mulberry, a buttonwood, black walnut, butternut, eight hickories, thirteen oaks, a chestnut, a beech, four tree birches, three willows of tree size, five poplars, three pines, three spruces, one hemlock, a balsam fir, one larch, one arbor-vitæ and a red cedar.

In all Europe there are only 85 species of trees.

WHY HAS MICHIGAN SO MANY TREES AND GREAT BRITAIN SO FEW.

This question now very naturally arises: Why has the Atlantic region, including Michigan, so many species of trees and why has Europe so few? Certainly we cannot attribute this difference to a defective soil and climate of Europe, as they now exist, for Europe can grow all sorts of trees now found in the temperate zone, while "Great Britain alone can grow double or treble the number of trees that the Atlantic States can."

The former geological conditions of their continents help to explain all this difference in the distribution of trees to the entire satisfaction of scientists.

Away back in the Tertiary Period the trees of the regions now possessing an arctic climate were such as now thrive in a warm temperate zone like that of Georgia and California. This is well illustrated by the abundant fossil remains of trees. Following this, came a long time when extreme cold prevailed, known as the Glacial Epoch, when snow and ice for most or all of the year extended to the Ohio river. At the approach of cold, the trees slowly retreated southward, as generation followed generation. The plants such as now thrive in southern Michigan, perhaps then extended to what now forms the State of Alabama, while the arctic plants reached Ohio.

As the climate again gradually grew warmer, the trees and other plants slowly migrated northward. Some arctic plants were stranded on the White mountains and in Labrador, where they still remain; others went farther north.

Plants of the cool temperate zone reached Michigan. In a similar manner, during the Glacial Epoch the plants of Europe were driven southward. The Alps, the Pyrenees, the Appenines, the Caucasus, still contain some of these arctic plants which retreated there at the close of the Glacial Epoch. Most of the plants of the warm temperate region had perished and therefore were unable to retreat when the continent became warmer.

I quote the words of Dr. A. Gray, from whom other hints are taken, as found in the American Journal of Science, page 194, 1878. "I conceive that three things have conspired to this loss. First, Europe hardly extending south of latitude 40°, is all within the limits generally assigned to severe glacial action. Second, its mountains trend east and west, from the Pyrenees to the Carpathians and the Caucasus beyond, near its southern border; and they had glaciers of their own, which must have begun operations, and poured down the northward flanks, while the plains were still covered with forest on the retreat from the great ice wave coming from the north. Attacked both on front and rear, much of the forest must have perished then and there. Third, across the line of retreat of those which may have flanked the mountain ranges, or were stationed south of them, stretched the Mediterranean, an impassable barrier.

"Greenland may be referred to, by way of comparison, as a country

which, having undergone extreme glaciation, bears the marks of it in the extreme poverty of its flora, and in the absence of the plants to which its southern portion, extending six degrees below the arctic circle, might be entitled. It ought to have trees, and might support them. But since destruction by glaciation, no way has been open for their return.

"In the American continent the mountains run north and south. The trees, when touched on the north by the on-coming refrigeration, had only to move their southern border southward, along an open way, and there was no impediment to their due return. So our lines have been cast in pleasant places, and the goodly heritage of forest trees is one of the consequences."

NATIVE FORAGE PLANTS.

The native grasses while young, from early spring to winter, without exception, furnish a tender bite which is very acceptable to all sorts of horses, cattle, sheep, and even swine and poultry. Most of the native grasses (about 120 in number) grow in isolated bunches, more or less frequent, and furnish but little food, while a considerable portion soon become unpalatable as the summer approaches. The most important native grasses for pasture or meadow are found in open places and are: June grass (not native), fowl meadow-grass, and several other species of *Poa* which have no well-known common name; several manna-grasses (*Panicularia*); a few small fescues, two or three Eatonias; blue-joint, two or three small redtops, and several species of Muhlenberg's grass, two or three kinds of mountain rice, reed-grass, two beard-grasses, and several panic grasses. The following, though quickly and thoroughly disseminated, are not native to our State: Barn-yard grass, crab-grass, foxtail or pigeon-grass, sweet vernal-grass, Timothy, meadow foxtail, the larger redtop so popular for lowlands, tall oat-grass, orchard grass, tall fescue, perennial rye-grass, quick-grass.

Besides the true grasses, there are about one hundred and eighty species of grass-like plants mostly found on marshes, which are called *sedges*. They are mostly confounded with the grasses except by the botanist. In addition to these are some twenty-five other narrow-leaved and grass-like plants known as *rushes* which furnish more or less herbage. Many of the sedges and rushes make hay of fair quality when cut early before they become harsh and woody.

On the Jack-pine plains and in many other portions of the sandy stumplands in the northern counties are two species of sedges found abundantly on dry land. These are *Carex Pennsylvanica* Lam., and *C. umbellata vicina* Dewey; they are popularly called grasses by the residents of those counties. Inquiries have frequently been made concerning the name, and statements made to the effect that they were very nutritious and that cattle got fat on them early in the spring. So far as I have observed, cattle prefer something else as it starts in spring, thus leaving the sedges untouched to grow all summer and remain green under the snow till the following spring. In spring the cattle eagerly devour the last year's growth of the sedges and thrive on it. This is but another evidence that the quality of the fodder is not of so great importance, provided animals can get enough of it, and can be induced to eat it.

Besides the native grasses, sedges and rushes, there are great numbers of other herbaceous plants, usually one here and there which are eaten by

hungry stock. Leaves and the tender growth of shrubs and young trees are often eaten in great quantities, and in times of scarcity cattle get astride of young trees bending down the tops so as to reach the leaves and twigs. Sheep eat the greatest variety of plants and thus where they feed closely are valuable aids in the clearing of a new country. They eat briars, elders and sprouts of stumps, but will leave some things which they do not like. The weeds that are thus left have an excellent chance to spread and in time occupy much of the ground once covered by the nutritious and edible plants which have been removed. Here we see one of the most excellent reasons for the interference of man in removing the weeds and in encouraging the introduction of the more valuable fodder plants. While these early native pastures and meadows are of incalculable value to the pioneer, without some care they soon deteriorate.

In times of great scarcity of feed in a new country, farmers used to fell trees that cattle might eat the twigs, or "browse," which contain much starch and protoplasm stored away by the trees ready to be used in giving the young growth a start on the approach of warm weather.

Michigan has no native species of clover.

NATIVE BEE PLANTS.

In Michigan there is a very large number of plants which furnish a good quality of honey. If the species is abundant in any region, it usually becomes known to the apiarist as a good bee plant; if not abundant it very likely fails to attract attention. A plant may be rare or important in one region and abundant in another. In autumn, asters and golden rods are known as excellent bee plants, because some few of the many species in the State are plentiful in nearly every neighborhood, but the same sorts of asters or golden rods do not everywhere throughout the State furnish a great amount of the honey. As a rule those plants which produce odorous or showy flowers afford honey and will be visited by honey bees unless the flower is of a shape which makes it impossible for the bee to reach the food.

Probably in the State there are of native plants, introduced weeds and field crops, a thousand species which furnish excellent food for bees. This is nearly one hundred times as many as the bee keeper has in mind, unless he has given unusual attention to the subject.

Our open low lands furnish a large proportion of the bee pasture; the forest some; the weeds and some of the field, garden and orchard crops a fair amount. Extremely dry or very wet weather are both unfavorable to the yield of honey. Drainage of the swamps and the clearing of waste places are unfavorable to the interests of the bee keeper.

As the botanist now looks at the subject, colors and odors are mere advertisements to call the attention of insects to the rich supplies of food in store for them. It may be said that the honey is there for the bees, but primarily it is there for the good of the plant, secondarily for the good of the insect. Had good old Dr. Watts lived in our day, he would have no doubt written his familiar verse in this way:

How doth the little busy bee
Improve each shining hour!
By carrying pollen day by day
To fertilize each flower.

WEEDS, NATIVE AND INTRODUCED.

A new country is comparatively free from weeds, but as the years pass by, one after another, weeds are introduced. Some of them are natives of the neighborhoods in which they are found, but most of them have been introduced from other portions of our own country or from foreign countries. The farmer is not inclined to adopt Emerson's notion of a weed as "a plant whose virtues have not yet been discovered," at least he doesn't purpose trying to find a use for them. The seeds of most weeds find their way onto a farm nicely mixed with seeds of grasses, grains and clovers, which are drilled in or sowed broadcast on fertile soil, where they are afforded an excellent opportunity to grow and multiply. In some instances weeds are introduced as a part of the packing or straw employed to protect castings, marble, crockery or fruit trees. Such foreign packing should always be burned at once.

By these processes the older the country the more troublesome weeds it will have, as every new intruder usually comes to stay. In most cases a weed becomes well established before it is discovered and the inquiry comes: "What is it, and how can I get rid of it?"

Weeds are likely to become most troublesome, where farmers are slovenly and where they are not thorough in cultivating throughout the season the so-called "hoed crops." In regions where "hoed crops" are seldom raised or only raised in small quantity, certain weeds are likely to prove very annoying. The majority of our weeds have been introduced from Europe, as will be seen by a comparison of the two lists which follow:

LIST OF WEEDS INTRODUCED FROM EUROPE AND ASIA.

The List includes at least seventy-eight species, and very likely more.
Abutilon Abutilon (L.) Rusby. Velvet Leaf.
(*Abutilon Avicennæ* Gaertn.)
Agrostemma Githago L. Corn Cockle.
(*Lychnis Githago* Scop.)
Alsine media L. Common Clickweed.
(*Stellaria media* Cyr.)
Alyssum alyssoides (L.) Gouan. Yellow Alyssum.
(*Alyssum calycinum* L.)
Amaranthus hybridus L. Slender Pigweed.
(*Amaranthus chlorostachys* Willd.)
Amaranthus retroflexus L. Rough Pigweed.
Anthemis Cotula L. May-weed.
Arctium Lappa L. Burdock.
Brassica arvensis (L.) B. S. P. Charlock.
(*Brassica Sinapistrum* Boiss.)
Brassica juncea (L.) Cosson. Indian Mustard.
Brassica nigra (L.) Koch. Black Mustard.
Bromus hordeaceus L. Soft-Chess.
(*Bromus mollis* L.)
Bromus racemosus L. Upright-Chess.
Bromus secalinus L. Cheat. Chess.
Bursa Bursa-pastoris (L.) Britton. Shepherd's Purse.
(*Capsella Bursa-pastoris* Medic.)
Camelina microcarpa Andrz. Small-fruited False-flax.
Camelina sativa (L.) Crantz. False-flax.
Carduus arvensis (L.) Robs. Canada Thistle.
(*Cnicus arvensis* Hoffm.)
Carduus lanceolatus L. Common or Bull Thistle.
(*Cnicus lanceolatus* Willd.)

Chaetochloa glauca (L.) Scribn. Yellow Fox-tail.
(*Setaria glauca* Beauv.)
Chaetochloa viridis (L.) Scribn. Green Fox-tail.
(*Setaria viridis* Beauv.)
Chenopodium album L. Lamb's Quarters. Pigweed.
Chenopedium glaucum L. Oak-leaved Goosefoot.
Chrysanthemum Leucanthemum L. White Daisy. Ox-Eye Daisy.
Cichorium Intybus L. Chicory.
Conium maculatum L. Poison Hemlock.
Convolvulus arvensis L. Bindweed.
Cynoglossum officinale L. Hound's-Tongue.
Datura Stramonium L. Stramonium. Thorn-apple.
Datura Tatula L. Purple Thorn-apple.
Daucus Carota L. Carrot.
Diplotaxis muralis (L.) DC. Sand Rocket.
(*Sisymbrium murale* L.)
Dipsacus sylvestris Huds. Wild Teasel.
Echinops sphaerocephalus L.
Eragrostis major Host. Stink grass.
Euphorbia Cyparissias L. Cypress Spurge.
Hypericum perforatum L. St. John's wort.
Inula Helenium L. Elecampane.
Lactuca Scariola L. Prickly Lettuce.
Lappula Lappula (L.) Karst. Stickseed.
(*Echinospermum Lappula* Lehm.)
Leonurus Cardiaca L. Motherwort.
Lepidium apetalum Willd. Apetalous Pepper-grass.
(*Lepidium intermedium* A. Gray.)
Lepidium sativum L. Pepper-grass.
Linaria Linaria (L.) Karst. Butter-and-eggs. Toad-flax.
(*Linaria vulgaris* Mill.)
Lithospermum arvense L. Red root. Corn Gromwell. Wheat Thief.
Malva rotundifolia L. Common Mallow.
Medicago lupulina L. Black Medic.
Melilotus alba Desf. White Melilot. Sweet Clover.
Nepeta Cataria L. Catnep. Catmint.
Panicum capillare L. Witch Grass.
Panicum Crus-galli L. Barnyard-Grass.
Plantago lanceoata L. Ribgrass. English Plantain.
Polygonum Convolvulus L. Black Bindweed.
Portulaca oleracea L. Purslane.
Ranunculus acris L. Buttercup.
Ranunculus bulbosus L. Buttercup.
Ranunculus repens L. Creeping Buttercup.
Roripa sylvestris (L.) Bess. Yellow Water-cress.
(*Nasturtium sylvestre* R. Br.)
Rumex Acetosella L. Field or Sheep Sorrel.
Rumex crispus L. Curled Dock.
Rumex obtusifolius L. Bitter Dock.
Salsola Tragus L. Russian Thistle.
Saponaria officinalis L. Soapwort. Bouncing Bet.
Silene noctiflora L. Night-flowering Catchfly.
Silene vulgaris (Moench) Garcke. Bladder Campion.
(*Silene Cucubalus* Wibel.)
Sisymbrium altissimum L. Tall Sisymbrium.
Sisymbrium officinale (L.) Scop. Hedge Mustard.
Sonchus arvensis L. Sow-Thistle.
Sonchus asper (L.) All. Spiny-leaved Sow-Thistle.
Sonchus oleraceus L. Snow-Thistle.
Syntherisma linearis (Krock.) Nash. Small Grab-grass.
(*Panicum glabrum* Gaud.)
Syntherisma sanguinalis (L.) Dulac. Crab-grass.
(*Panicum sanguinale* L.
Tanacetum vulgare L. Common Tansy.
Taraxacum Taraxacum (L.) Karst. Dandelion.

(*Taraxacum officinale* Weber.)
Tragopogon pratensis L. Goat's-beard.
Verbascum Blattaria L. Moth Mullen.
Verbascum Thapsus L. Mullen.
Xanthium spinosum L. Spiny Clot-bur.

LIST OF INDIGENOUS WEEDS.

This includes thirty-two species and very likely many more.
Acnida tamariscina tuberculata (Moq.) Uline & Bray. Water-hemp.
Acnida tamariscina prostrata Uline & Bray. Prostrate water-hemp.
Amaranthus blitoides S. Wats. Prostrate Amaranth.
Amaranthus graecizans L. Tumble-weed.
(*Amaranthus albus* L.) Tumble-weed.
Ambrosia artemisiaefolia L. Roman Wormwood. Hogweed. Ragweed.
Artemisia biennis Willd. Biennial Wormwood.
Asclepias Syriaca L. Common Milkweed.
(*Asclepias Cornuti* Decaisne.)
Bidens frondosa L. Beggar-ticks. Stick-tight.
Cenchrus tribuloides L. Hedge-hog or Bur-grass.
Chenopodium hybridum L. Maple-leaved Goosefoot.
Cyperus rotundus L. Nut-grass.
Cyperus esculentus L. Nut-Grass.
Erigeron annuus (L.) Pers. Fleabane.
Erigeron ramosus (Walt.) B. S. P. Daisy Fleabane.
(*Erigeron strigosus* Muhl.)
Euphorbia maculata L. Spotted Spurge.
Euphorbia nutans Lag. Spurge.
(*Euphorbia Preslii* Guss.)
Hedeoma pulegioides (L.) Pers. Pennyroyal.
Helianthus tuberosus L. Jerusalem Artichoke.
Iva xanthiifolia (Fresen.) Nutt. Marsh Elder.
Lepidium Virginicum L. Peppergrass.
Leptilon Canadense (L.) Britton. Horse-weed. Fleabane.
(*Erigeron Canadensis* L.)
Onagra biennis (L.) Scop. Evening-primrose.
(*Œnothera biennis* L.)
Panicum capillare L. Old-witch Grass.
Plantago major L. Plantain.
Plantago Rugelii Decaisne. Plantain.
Polygonum aviculare L. Knotgrass.
Polygonum erectum L. Erect Knotgrass.
Polygonum littorale Link. Shore Knotweed.
Prunella vulgaris L. Heal-all.
(*Brunella vulgaris* L.)
Rudbeckia hirta L. Yellow Daisy. Black-eyed Susan.
Urtica gracilis Ait. Tall Wild Nettle.
Xanthium Canadense Mill. Cocklebur. Clotbur.

NATIVE POISONOUS PLANTS.

Besides two species of nettles, *Urtica gracilis* Ait., and *Urticastrum divaricatum* (L.) Kuntze, there are only two species of native plants which are of any prominence as poisonous to the touch, and often these two are not poisonous to all persons. The latter plants or shrubs are known as poison sumach or poison dogwood (*Rhus Vernix* L.), and poison ivy, or poison oak (*Rhus radicans* L.). The last named plant is the most troublesome, as it is often common on dry land, while the one previously noticed is confined to swamps which are not so often frequented. Poison ivy has three leaflets to each leaf, while the handsome Virginian Creeper, often confounded with it, usually has five leaflets to the leaf, and is harmless. The roots, leaves or flowers of many of the

medicinal plants are more or less poisonous when eaten in sufficient quantity, but fortunately, in nearly all such cases, there is something repulsive to the taste or to the smell. Unless one is a botanist or takes the advice of a good botanist, it is safest to let strange plants alone.

NATIVE PLANTS FAST DISAPPEARING.

The fathers and grandfathers of many of us spent a considerable portion of their energies in clearing away trees, shrubs, and breaking up the land that they might have fertile fields. The newer portions of our State are still rapidly undergoing this same transition.

As the country becomes older and more thickly settled almost everything seems to conspire against the trees and smaller plants. Proprietors are still making extensions to their clearings. The "tidy" farmer ditches the cat-holes and marshes, clears out the elders and viburnums to make more room for turnips and better grasses. He turns stock into the wood lot and the flowers of spring and summer retreat to the brush-heaps and a few places inaccessible to the cattle. Fire burns out the dried-up swamps. The officers of the railroad see that the strips alongside the track are often mowed. The highways are attacked and the larger vegetation removed. In places, nurserymen or their agents collect large numbers of the choicer wild plants, as prairie roses and lady's slippers. Near high schools and colleges, the student collectors exterminate many choice plants, root and branch. Many wild plants vigorously protest against these attempts toward their extermination, and start again and again to recover the lost ground, but with the hand of a thorough farmer against them, sooner or later they succumb, the scattered remnants only surviving in the few remaining swamps, along railroads, on a few ragged hills and out of the way places.

Let me utter a vigorous protest against the practice of collecting great quantities of flowers, just to carry home and throw away. And may I hope that every teacher who chances to read this paragraph will also utter a protest against this practice?

LIST OF TREES INDIGENOUS TO MICHIGAN.

The distinction between a tree and a shrub is a purely arbitrary one. If the trunk attains a diameter of one foot the species ranks as a tree, if less than a foot it ranks as a shrub. The papaw and the witch-hazel rank as trees in some regions of the country, but in Michigan I have not included them in the list of trees of the State. I enumerate ninety trees for Michigan.

Abies balsamea (L.) Miller. Balsam Fir.
Acer Negundo L. Box Elder. Ash-leaved Maple. Box Elder.
(*Negundo aceroides* Moench.)
Acer nigrum Michx. Black Sugar Maple.
(*Acer saccharinum nigrum* T. & G.)
Acer Pennsylvanicum L. Striped maple.
Acer rubrum L. Red Maple. Soft Maple.
Acer saccharinum L. Silver Maple. Soft Maple.
(*Acer dasycarpum* Ehrh.)
Acer Saccharum Marsh. Sugar Maple.
(*Acer saccharinum* Wang.)
Æsculus glabra Willd. Fetid or Ohio Buckeye.
Amelanchier Botryapium (L. f.) DC. Shad-bush.

Amelanchier Canadensis (L.) Medic. Shad-bush. June-berry.
Betula lenta L. Cherry Birch. Sweet B. Black B.
Betula lutea Michx. f. Yellow or Gray Birch.
Betula papyrifera Marshall. Paper or Canoe Birch.
Carpinus Caroliniana Walt. Blue Beech.
Castanea dentata (Marsh.) Borkh. Chestnut.
(*Castanea sativa Americana* A. Gray.)
Celtis occidentalis L. Hackberry.
Cercis Canadensis L. Red Bud. Judas tree.
Cornus florida L. Flowering Dogwood.
Crataegus Crus-galli L. Cockspur Thorn.
Crataegus gemmosa Sargent.
Crataegus macracantha Lodd. Long-spined Thorn.
(*Crataegus coccinea macracantha* Dudley.)
Crataegus mollis (T. & G.) Scheele. Hawthorn.
(*Crataegus coccinea mollis* Torr & Gray.)
Crataegus punctata Jacq. Hawthorn.
Crataegus tomentosa L. Hawthorn.
Fagus Americana Sweet. Beech.
(*Fagus ferruginea* Ait.)
Fraxinus Americana L. White Ash.
Fraxinus lanceolata Borck. Green Ash.
(*Fraxinus viridis* Michx.)
Fraxinus nigra Marsh. Black Ash.
(*Fraxinus sambucifolia* Lam.)
Fraxinus Pennsylvanica Marsh. Red Ash.
(*Fraxinus pubescens* Lam.)
Fraxinus quadrangulata Michx. Blue Ash.
Gleditsia triacanthos L. Honey-Locust.
Gymnocladus dioica (L.) Koch. Kentucky Coffee-tree.
(*Gymnocladus Canadensis* Lam.)
Hicoria alba (L.) Britton. Mocker-nut.
(*Carya tomentosa* Nutt.)
Hicoria borealis Ashe. Northern Hickory.
Hicoria glabra (Mill.) Britton. Pig-nut Hickory.
(*Carya porcina* Nutt.)
Hicoria laciniosa (Michx. f.) Sargent. King-nut, Big Shell-bark Hickory.
(*Carya sulcata* Nutt.)
Hicoria microcarpa (Nutt.) Britton. Small Pig-nut Hickory.
(*Carya microcarpa* Nutt.)
Hicoria minima (Marsh.) Britton. Bitter-nut Hickory.
(*Carya amara* Nutt.)
Hicoria ovata (Mill.) Britton. Shag-bark Hickory.
(*Carya alba* Nutt.)
Hicoria villosa Ashe.
Juglans cinerea L. Butternut.
Juglans nigra L. Black Walnut.
Juniperus Virginiana L. Red Cedar.
Larix laricina (Du Roi.) Koch. Tamarack. American Larch.
(*Larix Americana* Michx.)
Liriodendron Tulipifera L. Tulip-tree. Whitewood.
Morus rubra L. Red Mulberry.
Nyssa sylvatica Marsh. Pepperidge. Tupelo. Black or Sour Gum.
Ostrya Virginiana (Mill.) Willd. Ironwood. Hop-hornbeam.
Picea brevifolia Peck. Swamp Spruce.
Picea Canadensis (Mill.) B. S. P.
(*Picea alba* Link.)
Picea Mariana (Mill.) B. S. P. Black Spruce.
(*Picea nigra* Link.)
Pinus divaricata (Ait.) Gord. Jack or Scrub Pine.
(*Pinus Banksiana* Lambert.)
Pinus resinosa Ait. Norway or Red Pine.
Pinus Strobus L. White Pine.
Platanus occidentalis L. Buttonwood. Sycamore.
Populus balsamifera L. Balsam Poplar.

Populus candicans Ait. Balm of Gilead.
(*P. balsamifera candicans* A. Gray.)
Populus deltoides Marsh. Cottonwood.
(*Populus monilifera* Ait.)
Populus grandidentata Michx. Large-toothed Aspen.
Populus heterophylla L. Downy Poplar.
Populus tremuloides Michx. American Aspen.
Prunus nigra Ait. Canada Plum. Horse Plum.
Prunus Pennsylvanica L. f. Wild Red Cherry. Pin Cherry.
Prunus serotina Ehrh. Black Cherry.
Prunus Virginiana L. Choke Cherry.
Quercus acuminata (Michx.) Houda. Chestnut Oak.
(*Quercus Muhlenbergii* Engelm.)
Quercus alba L. White Oak.
Quercus Alexanderi Britton. Alexander's Oak.
Quercus ellipsoidalis E. J. Hill. Hill's Oak.
Quercus coccinea Wang. Scarlet Oak.
Quercus imbricaria Michx. Shingle Oak.
Quercus macrocarpa Michx. Bur Oak.
Quercus minor (Marsh.) Sargent. Post Oak.
(*Quercus obtusiloba* Michx.)
Quercus palustris DuRoi. Pin Oak.
Quercus platanoides (Lam.) Sudw. Swamp White Oak.
(*Quercus bicolor* Willd.)
Quercus rubra L. Red Oak.
Quercus Schneckii Britton. Schneck's red oak.
(*Q. Texana* Sargent.)
Quercus velutina Lam. Black Oak.
(*Quercus tinctoria* Bartram.)
Salix amygdaloides Anders. Willow.
Salix nigra Marsh. Black Willow.
Sassafras Sassafras (L.) Karst. Sassafras.
(*Sassafras officinale* Nees.)
Sorbus Americana Marsh. American Mountain Ash.
(*Pyrus Americana* DC.)
Sorbus sambucifolia (C. & S.) Roem. Western Mountain Ash.
(*Pyrus sambucifolia* C. & S.)
Thuja occidentalis L. White Cedar. Arbor Vitae.
Tilia Americana L. Basswood. Linden.
Tsuga Canadensis (L.) Carr. Hemlock.
Ulmus Americana L. American Elm.
Ulmus fulva Michx. Slippery or Red Elm.
Ulmus racemosa Thomas. Rock Elm.
Viburnum Lentago L. Sheep-berry.

Four or more hybrid oaks have been found, but these were not enumerated above. They are: Quercus alba× macrocarpa, Quercus Leana,= Q. velutina× imbricaria, Quercus platanoides× macrocarpa, Quercus imbricaria× rubra.

LIST OF SHRUBS INDIGENOUS TO MICHIGAN.

There are two hundred and nine species and varieties.

Acer Pennsylvanicum L. Striped Maple.
Acer spicatum Lam. Mountain Maple.
Alnus Alnobetula (Ehrh.) K. Koch. Green Alder.
(*Alnus viridis* DC.)
Alnus incana (L.) Willd. Speckled Alder.
Alnus rugosa (DuRoi.) K. Koch. Smooth Alder.
Amelanchier alnifolia Nutt. June or Service Berry.
Amelanchier rotundifolia (Michx.) Roem. June or Service Berry.
Amorpha canescens Pursh. Lead-plant.
Andromeda Polifolia L. Wild Rosemary.
Aralia hispida Vent. Bristly Sarsaparilla.
Arctostaphylos Uva-Ursi (L.) Spreng. Bearberry.
Aronia arbutifolia (L.) Medic. Red Chokeberry.
Aronia nigra (Willd.) Britton. Black Chokeberry.

(*Pyrus arbutifolia* L. f.)
Aronia nigra (Willd.) Britton.
(*Pyrus arbutifolia melanocarpa* Hook.)
Asimina triloba (L.) Dunal. Papaw.
Benzoin Benzoin (L.) Coulter. Spice-bush.
(*Lindera Benzoin* Blume.)
Betula glandulosa Michx. Glandular Birch.
Betula pumila L. Low Birch.
Ceanothus Americanus L. New Jersey Tea. Red-root.
Ceanothus ovatus Desf. Smaller Red-root.
Celastrus scandens L. Shrubby or Climbing Bittersweet.
Cephalanthus occidentalis L. Button-bush.
Chamaedaphne calyculata (L.) Moench. Leather-leaf.
(*Cassandra calyculata* D. Don.)
Comptonia peregrinia (L.) Coulter. Sweet-fern.
(*Myrica asplenifolia* L.)
Cornus alternifolia L. f. Alternate-leaved Cornel.
Cornus Amonum Mill. Kinnikinnik.
(*Cornus sericea* L.)
Cornus Baileyi Coult. & Evans. Bailey's Cornel.
Cornus candidissima Marsh. Panicled Cornel.
(*Cornus paniculata* L. Her.)
Cornus circinata L. Her. Round-leaved Cornel.
Cornus stolonifera Michx. Red-osier Cornel.
Cornus stricta Lam. Stiff Cornel.
Corylus Americana Walt. Hazel-nut.
Corylus rostrata Ait. Beaked Hazel-nut.
Crataegus acutiloba Sargent.
Crataegus albicans Ashe.
Crataegus altrix Ashe.
Crataegus ater Ashe.
Crataegus attenuata Ashe.
Crataegus borealis Ashe.
Crataegus brevispina (Dougl.) Farwell.
(*Crataegus punctata brevispina* Dougl.)
Crataegus caesa Ashe.
Crataegus coccinea L.
Crataegus decans Ashe.
Crataegus Dodgei Ashe.
Crataegus fallax Ashe.
Crataegus filipes Ashe.
Crataegus glareola Ashe.
Crataegus immanis Ashe.
Crataegus latisepala Ashe.
Crataegus lanta Ashe.
Crataegus lumaria Ashe.
Crataegus Michiganensis, Ashe.
Crataegus nuperia Ashe.
Crataegus obtecta Ashe.
Crataegus onusta Ashe.
Crataegus pascens Ashe.
Crataegus pastora Sargent.
Crataegus prona Ashe.
Crataegus prunifolia (Marsh.) Pers.
Crataegus pubifolia Ashe.
Crataegus pubipes Ashe.
Crataegus rotundifolia (Ehrh.) Borck.
Crataegus redolans Ashe.
Crataegus sera Sargent.
Crataegus structilis Ashe.
Crataegus tenax Ashe.
Crataegus virella Ashe.
Dasiphora fruticosa (L.) Rybd. Shrubby Cinquefoil.
(*Potentilla fruticosa* L.)
Decodon verticillatus (L.) Ell. Willow Herb.

Diervilla Diervilla (L.) Mac M. Bush Honeysuckle.
(*Diervilla trifida*, Moench.)
Empetrum nigrum L. Black Crowberry.
Epigaea repens L. Trailing Arbutus. Mayflower.
Euonymus atropurpureus Jacq. Burning Bush. Wahoo.
Euonymus obovatus Nutt. Running Strawberry Bush.
(*Enonymus Americanus obovatus* T. & G.)
Gaylussacia resinosa (Ait.) T. & G. Black Huckleberry.
Hypericum Kalmianum L. Kalm's St. John's-wort.
Hypericum prolificum L. Shrubby St. John's-wort.
Ilex verticillata (L.) A. Gray. Winter-berry.
Ilicioides mucronata (L.) Britton. Mountain Holly.
(*Nemopanthes Canadensis* DC.)
Kalmia angustifolia L. Sheep-laurel.
Kalmia glauca Ait. Swamp-laurel.
Ledum Groenlandicum Œlder. Labrador Tea.
(*Ledum latifolium* Ait.)
Lepargyraea argentea (Nutt.) Greene. Buffalo-berry.
(*Shepherdia argenta* Nutt.)
Lonicera Caprifolium L. Perfoliate Honeysuckle.
(*Lonicera grata* Ait.)
Lonicera ciliata Muhl. Fly Honeysuckle.
Lonicera coerulea L. Mountain Fly-Honeysuckle.
Lonicera dioica L. Glaucous Honeysuckle.
(*Lonicera glauca* Hill.)
Lonicera glaucescens Rydb. Douglas' Honeysuckle.
Lonicera hirsuta Eaton. Hairy Honeysuckle.
Lonicera involucrata (Richards) Banks.
Lonicera oblongifolia (Goldie) Hook. Swamp Fly-Honeysuckle.
Malus coronaria (L.) Mill. American Crab Apple.
(*Pyrus coronaria* L.)
Menispermum Canadense L. Moonseed.
Myrica cerifera L. Bayberry. Wax-myrtle.
Myrica Gale L. Sweet Gale.
Opulaster opulifolius (L.) Kuntze. Ninebark.
(*Physocarpus opulifolius* Maxim.)
Oxycoccus macrocarpus (Ait.) Pers. Large Cranberry.
(*Vaccinium macrocarpon* Ait.)
Oxycoccus Oxycoccus (L.) MacM. Small Cranberry.
(*Vaccinium Oxycoccus* L.)
Parthenocissus quinquefolia (L.) Planch. Virginia Creeper.
(*Ampelopsis quinquefolia* Michx.)
Parthenocissus quinquefolia laciniata Planch.
(*Parthenocissus vitacea* Planch.)
Parthenocissus quinquefolia hirsuta (Knerr.) T. & G.
Polycodium stamineum (L.) Greene. Deerberry.
(*Vaccinium staminium* L.)
Prunus Americana Marsh. Wild Yellow or Red Plum.
Prunus pumila L. Sand Cherry. Dwarf Cherry.
Ptelea trifoliata L. Hop-tree. Wafer-ash.
Quercus prinoides Willd. Dwarf Chestnut Oak.
Rhamnus alnifolia L'Her. Dwarf Alder.
Rhus aromatica Ait. Fragrant Sumach.
(*Rhus Canadensis* Marsh.)
Rhus copalina L. Dwarf Sumach.
Rhus glabra L. Smooth Sumach.
Rhus hirta (L.) Sudw. Staghorn Sumach.
(*Rhus typhina* L.)
Rhus radicans L. Poison Ivy.
(*Rhus Toxicodendron radicans* Marsh.)
Rhus Vernix L. Poison Sumach.
(*Rhus venenata* DC.)
Ribes Cynosbati L. Prickly Gooseberry.
Ribes floridum L'Her. Wild Black Currant.
Ribes gracile Michx. Missouri Gooseberry.

Ribes lacustre (Pers.) Poir. Swamp Gooseberry.
Ribes oxyacanthoides lacustre Pers.
Ribes oxyacanthoides L. Swamp Gooseberry.
Ribes prostratum L'Her. Fetid Currant.
Ribes rotundifolium Michx. Round-leaved Gooseberry.
Ribes rubrum L. Red Currant.
(*Ribes rubrum subglandulosum* Maxim.)
Rosa Arkansana Porter.
Rosa blanda Ait.
Rosa Carolina L. Swamp Rose.
Rosa Carolina× humilis C. F. Wheeler. A hybrid.
Rosa Engelmanni S. Wats.
Rosa humilis Marsh. Low Rose.
Rosa Sayi Schwein. Say's Rose.
Rosa setigera Michx. Prairie Rose.
Rubus Americanus (Pers.) Britton.
(*Rubus triflorus* Richards.)
Rubus Canadensis L. Low Dewberry.
(*Rubus Millspaughii* Britton.)
Rubus hispidus L. Running Swamp Dewberry.
Rubus nigrobaccus Bailey. Blackberry.
(*Rubus villosus* Ait.)
Rubus occidentalis L. Black Raspberry.
Rubus odoratus L. Purple Flowering-raspberry.
Rubus parviflorus Nutt. Salmon-Berry.
(*Rubus Nutkanus* Mocino.)
Rubus setosus Bigel. Bristly Blackberry.
Rubus strigosus Michx. Wild Red Raspberry.
Salix adenophylla Hook. Tomentose Willow.
Salix amygdaloides Anders. Peach-leaved Willow.
Salix balsamifera (Hook) Barratt. Balsam Willow.
Salix balsamifera lanceolata Bebb.
Salix balsamifera vegeta Bebb.
Salix Bebbiana Sargent. Bebb's Willow.
(*Salix rostrata* Richards.)
Salix candida Fluegge. Hoary Willow.
Salix candida× cordata Bebb. A hybrid.
Salix cordata Muhl. Heart-leaved Willow.
Salix cordata× sericea Bebb.
Salix discolor Muhl. Glaucous Willow.
Salix discolor× eriocephala Anders.
Salix discolor× prinoides (Pursh) Anders.
Salix fluviatilis Nutt. Sandbar Willow.
(*Salix longifolia* Muhl.)
Salix fragilis L.
Salix fragilis× alba Wimmer.
Salix glaucophylla Bebb. Broad-leaved Willow.
Salix glaucophylla× angustitolia Bebb.
Salix glaucophylla× brevifolia Bebb.
Salix humilis Marshall. Prairie Willow.
Salix humilis× discolor Bebb.
Salix interior× Wheeleri Rowlee.
Salix lucida Muhl. Shining Willow.
Salix myrtilloides L. Myrtle Willow.
Salix myrtilloides× pedicellaris Anders.
Salix nigra Marshall. Black Willow.
Salix nigra falcata (Pursh) Torr.
Salix petiolaris J. E. Smith. Petioled Willow.
Salix petiolaris gracilis Anders.
Salix petiolaris× candida Bebb.
Salix sericea Marsh. Silky Willow.
Salix sericea× candida Bebb.
Salix tristis Ait. Dwarf Gray Willow.
Salix viminalis L. Basket Osier.
Sambucus Canadensis L. Purple-berried Elder.

Sambucus pubens Michx. Red-berried Elder.
Smilax hispida Muhl. Green Briar.
Smilax rotundifolia L. Green Briar.
Spiraea salicifolia L. Willow-leaved Meadow-sweet.
Spiraea tomentosa L. Hardhack.
Staphylea trifolia L. Bladdernut.
Symphoricarpos occidentalis Hook. Wolfberry.
Symphoricarpos pauciflorus (Robbins) Britton. Low Snowberry.
Symphoricarpos racemosus Michx. Snowberry.
Symphoricarpos Symphoricarpos (L.) MacM. Coral-berry.
(*Symphoricarpos vulgaris* Michx.)
Vaccinium caespitosum Michx. Dwarf Bilberry.
Vaccinium Canadense Richards. Canada Blueberry.
Vaccinium corymbosum L. Swamp-blueberry.
Vaccinium corymbosum amoenum A. Gray.
Vaccinium membranaceum Dougl. Thin-leaved Bilberry.
(*Vaccinium myrtilloides* Hook.)
Vaccinium nigrum (Wood) Britton. Black Blueberry.
Vaccinium ovalifolium J. E. Smith. Oval-leaved Bilberry.
Vaccinium Pennsylvanicum Lam. Dwarf or Low-bush Blueberry.
Vaccinium Pennsylvanicum angustifolium (Ait.) A. Gray.
Vaccinium uliginosum L. Great Bilberry.
Vaccinium vacillans Kalm. Low Blueberry.
Viburnum acerifolium L. Maple-leaved Arrow-wood.
Viburnum alnifolium Marsh. Hobble-bush.
(*Viburnum lantanoides* Michx.)
Viburnum cassinoides L. Withe-rod.
Viburnum dentatum L. Arrow-wood.
Viburnum Opulus L. Cranberry-tree.
Viburnum pauciflorum Pylaie. Few-flowered Cranberry-tree.
Viburnum prunifolium L. Black Haw.
Viburnum pubescens (Ait.) Pursh.
Vitis aestivalis Michx. Summer Grape.
Vitis bicolor LeConte. Blue or Winter Grape.
Vitis cordifolia Michx. Forest Grape.
Vitis vulpina L. Riverside Grape.
(*Vitis riparia* Michx.)
Xanthoxylum Americanum Mill. Prickly Ash.
Xolisma ligustrina (L.) Britton. Privet Andromeda.

CATALOGUE.

Range of species north or south has been indicated by the following abbreviations at the right: S.—1st, 2d and 3d tiers of counties. C.—From 3d tier of counties northward to Houghton Lake region. N.—Remainder of the Lower Peninsula. L. P.—Lower Peninsula. U. P.—Upper Peninsula. Th.—Whole State so far as known. In a few instances S. E. and S. W. have been used to indicate the southeastern and southwestern parts of the Lower Peninsula. In case of rare or local species, I have given all the localities known, but for more common ones, have usually indicated only the range and relative frequency. Throughout the catalogue B. & K. refer to notes of H. C. Beardslee and Chas. A. Kofoid. W. J. B.—W. J. Beal. All plants which have been collected within ten miles of Lansing are indicated by an asterisk.*

OPHIOGLOSSACEÆ Presl. Adder's-Tongue Family.

OPHIOGLOSSUM L.

1. O. Engelmanni Prantl. Keweenaw Co., O. A. Farwell.

*2. O. vulgatum L. Adder's tongue. Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge; Manistee, F. P. Daniels; Ann Arbor, C. A. Davis; due north of the Agricultural College on the Zac. Chandler farm; very likely overlooked in most places where it might be found. Rare.

BOTRYCHIUM Swartz.

2a. **B. boreale** (Fries.) Milde. Keweenaw Co., O. A. Farwell.
3. **B. dissectum** Spreng. *B. ternatum dissectum* D. C. Eaton. South Haven, Bailey; Detroit, Foerste; Alma, C. A. Davis; St. Clair Co., J. W. Stacey.
4. **B. lanceolatum** (S. G. Gmel.) Angstroem. Lance-leaved Grape-fern. Damp, mossy places. Lake Superior, H. Gillman; Keweenaw Co., O. A. Farwell.
5. **B. Lunaria** (L.) Swartz. Moonwort. "Lake Superior (Lesquereux.) and sparingly northward," Eaton in Gray's Manual; Keweenaw Co., O. A. Farwell; Harrisville, W. J. B. Rare.
6. **B. matricariae** (Schrank.) Spreng. Keweenaw Co., O. A. Farwell.
7. **B. matricariaefolium** A. Braun. Dark, wet woods. Lake Superior, D. C. Eaton; Keweenaw Co., O. A. Farwell.
8. **B. obliquum** Muhl. *B. ternatum obliquum* D. C. Eaton. Pastures and meadows. Fort Gratiot and S. Mich., Winch. Cat.; Flint; S. Haven, Bailey; Ann Arbor, Allmendinger Cat.; Gratiot Co.; Keweenaw Co., Detroit, O. A. Farwell; Berrien Co., H. S. Pepoon. Infrequent.
8a. **B. obliquum intermedium** (D. C. Eaton) Underw. *B. ternanatum australe* D. C. Eaton. Keweenaw Co., O. A. Farwell.
9. **B. Onondagense** Underw. Keweenaw Co., O. A. Farwell.
10. **B. simplex** Hitchcock. Little Grape-fern. Hillsides. Westward to Lake Superior, D. C. Eaton, Ferns of N. Am.; Keweenaw Co., O. A. Farwell; near Oscoda in 1888, the only station known in the Lower Peninsula. Rare.
11. **B. tenebrosum** A. A. Eaton. Keweenaw Co., O. A. Farwell.
*12. **B. Virginianum** (L.) Swartz. Virginia Grape-Fern. Rich woods. Variable. Common.
13. **B. Virginianum gracile** Pursh. With type.

OSMUNDACEÆ R. Br. Royal Fern Family.

OSMUNDA L.

*18. **O. cinnamomea** L. Cinnamon Fern. Swamps. Common.
*19. **O. Claytoniana** L. Clayton's Fern. Moist grounds, common. Th.
*20. **O. regalis** L. Flowering Fern. Swamps, common.

POLYPODIACEÆ R. Br. Fern Family.

ONOCLEA L.

*21. **O. sensibilis** L. Sensitive Fern. Wet places. Abundant. Th.

MATTEUCCIA Todaro. ONOCLEA L. in part.

*22. **M. Struthiopteris** (L.) Todaro. Ostrich Fern. *Onoclea Struthiopteris* (L.) Hoffm. Alluvial soil. Infrequent. Th.

WOODSIA R. Br.

23. **W. alpina** (Bolton) S. F. Gray. Alpine Woodsia. *W. hyperborea* R. Br. U. P., O. A. Farwell.
24. **W. Ilvensis** (L.) R. Br. Rusty Woodsia. N. E., Winch. Cat.; Lake Superior, Whitney Cat.; Lower Falls of the Quinnesec, E. J. Hill; Norway, C .F. Wheeler.
25. **W. obtusa** (Spreng.) Torr. Blunt-lobed Woodsia. Rocky places. Huron Co., C. A. Davis. U. P. Not rare.
26. **W. Oregana** D. C. Eaton. Oregon Woodsia. Crevices of rocks south shore of Lake Superior, Dr. Robbins in Gray's Manual.
27. **W. scopulina** D. C. Eaton. Rocky Mountain Woodsia. Rocks of the lower falls of the Menominee river, C. F. Wheeler.

DENNSTAEDTIA Bernh. DICKSONIA L'Her.

28. **D. punctilobula** (Michx.) Moore. *Dicksonia punctilobula* (Michx.) A. Gray. Petoskey, Emmet Co., Winch. Cat.; Keweenaw Co., O. A. Farwell.

FILIX Adans. CYSTOPTERIS Bernh.

*29. F. bulbifera (L.) Underw. *Cystopteris bulbifera* (L.) Bernh. Bulblet Fern. Moist shaded hillsides. Locally frequent. Th.

*30. F. fragilis (L.) Underw. *Cystopteris fragilis* (L.) Bernh. Brittle Fern. Woods and river banks. Ann Arbor, Allmend. Cat.; Flint; Hubbardston; Alma, C. A. Davis; northward to Lake Superior, Whitney. Th.

31. F. fragilis tenue (Michx.) *Cystopteris fragilis dentata* Hook. Keweenaw Co., and Ypsilanti, O. A. Farwell.

32. F. montana (Lam.) Underw. Mountain Cystopteris. *Cystopteris montana* (Lam.) Bernh. North shore of Lake Superior, Britton & Brown.

POLYSTICHUM Roth. ASPIDIUM in part.

33. P. acrostichoides (Michx.) Schott. Christmas Fern. *Aspidium acrostichoides* Sw. Shady ground. Th.

34. P. Braunii (Spenner) Fée. Braun's Holly-fern. *Aspidium aculeatum Braunii* Doell. Ontonagon Peninsula, Eaton's Ferns of N. A.; Keweenaw Co., O. A. Farwell.

35. P. Lonchitis (L.) Roth. Holly-Fern. *Aspidium Lonchitis* Sw. Woods south shore of Lake Superior, Prof. Whitney; Keweenaw Co., O. A. Farwell.

DRYOPTERIS Adans. ASPIDIUM in part.

36. D. Boottii (Tuckerm.) Underw. Boott's Shield-fern. *Aspidium Boottii* Tuckerm. Alder thickets. Hubbardston; Ann Arbor, Winch. Cat.; Norway, C. F. Wheeler; Keweenaw Co., O. A. Farwell.

*37. D. cristata (L.) A. Gray. Crested Shield-fern. *Aspidium cristatum* Sw. Swamps. Frequent. Th.

38. D. cristata Clintoniana (D. C. Eaton) Underw. *Aspidium cristatum Clintonianum* D. C. Eaton. Ann Arbor, Allmendinger Cat.; Hubbardston; found at Lake Nipigon, Ont., Macoun; Alma, C. A. Davis. Infrequent. Th.

39. D. Filix-Mas (L.) Schott. Male Fern. *Aspidium Filix-mas* Sw. Rocky woods. Keweenaw Peninsula, Lake Superior, A. Gray.

40. D. fragrans (L.) Schott. Fragrant Shield-fern. *Aspidium fragrans* Sw. Crevices of shaded cliffs. Isle Royale, and Keweenaw Peninsula, Dr. Lyons.

*41. D. Goldieana (Hook.) A. Gray. Goldie's Fern. *Aspidium Goldieanum* Hook. Moist woods. Flint; Hubbardston, C. F. Wheeler; Owosso, G. H. Hicks; Black River, St. Clair Co., C. K. Dodge; Alma, C. A. Davis.

*42. D. marginalis (L.) A. Gray. Evergreen Wood-fern. *Aspidium marginale* Sw. Hillsides in rich woods. S. Haven, Bailey; Flint; Hubbardston and northward. Frequent. Th.

*43. D. Noveboracensis (L.) A. Gray. New York Fern. *Aspidium Noveboracense* Sw. Swamps. Ann Arbor, Allmendinger Cat.; Macomb Co.; Hubbardston; Gore Bay, Manitoulin Island, J. Bell. Canadian Cat. L. P.

44. D. simulata Davenport. Belle Isle, O. A. Farwell.

*45. D. spinulosa (Retz) Kuntze. Spinulose Shield-fern. *Aspidium spinulosum* Sw. Shady woods. Flint; Hubbardston; L. Superior, D. C. Eaton, Ferns of N. A. Th.

46. D. spinulosa dilatata (Hoffm.) Underw. *Aspidium spinulosum* var. *dilatatum* Hook. Woods. Ann Arbor, Allmendinger Cat.; Macomb Co.; Flint; Hubbardston; Petoskey, and northward. Th.

*47. D. spinulosa intermedia (Muhl.) Underw. *Aspidium spinulosum* var. *intermedium* D. C. Eaton. Woods. Common. Th.

*48. D. Thelypteris (L.) A. Gray. Marsh Shield-fern. *Aspidium Thelypteris* Sw. Swamps. Frequent. Th.

PHEGOPTERIS Fée.

*49. P. Dryopteris (L.) Fée. Oak-fern. Open woods. Frequent north of lat. 43°, especially under pines. Th.

*50. P. hexagonoptera (Michx.) Fée. Broad Beech-fern. Beech woods. Flint; Hubbardston; Ann Arbor, Allmendinger Cat.; Keweenaw Co., O. A. Farwell. Frequent. Th.

*51. **P. Phegopteris** (L.) Underw. Long Beech-fern. *P. polypodioides* Fée. Isle Royale, Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell; Frankfort; Inland, Grand Traverse Co.; rocks, Grand Ledge. Abundant northward. Th.

WOODWARDIA J. E. Smith.

52. **W. areolata** (L.) Moore. Net-veined Chain-fern. *W. angustifolia* J. E. Smith. South Haven, L. H. Bailey in 1880; near Black River, St. Clair Co., C. K. Dodge.
*53. **W. Virginica** (L.) J. E. Smith. Virginia Chain-fern. Marshes, Marquette Co., Burt. MS. Cat.; Westville, Montcalm Co.; Flint; So. Haven, Bailey; Hubbardston, C. F. Wheeler; Ann Arbor, Allmendinger Cat.; near Port Huron, C. K. Dodge. Th.

CAMPTOSORUS Link.

54. **C. rhizophyllus** (L.) Link. Walking-fern. Keweenaw Co., O. A. Farwell; Alpena, V. M. Spalding, C. F. Wheeler; Norway on the northeast exposure of quartz rock, C. F. Wheeler. Rare.

ASPLENIUM L.

*55. **A. acrostichoides** Sw. Silvery Spleenwort. *A. thelypteroides* Michx. Rich woods. Frequent. Th.
*56. **A. angustifolium** Michx. Narrow-leaved Spleenwort. Rich woods, S. W., Wright Cat.; Ann Arbor, rare, Allmendinger Cat.; Flint; S. Haven, Bailey; Ionia Co. Infrequent. C. & S.
*57. **A. Filix-foemina** (L.) Bernh. Lady Fern. Moist woods. Exceedingly variable. Common. Th.
58. **A. montanum** Willd. Mountain Spleenwort. Near Clifton, Keweenaw Co., O. A. Farwell.
59. **A. platyneuron** (L.) Oakes. Ebony Spleenwort. *A. ebeneum* Ait. Allegan, Miss Josie A. Williams. Only station known in the State.
60. **A. Rutra-muraria** L. Wall Rue Spleenwoort. N. E., Winch. Cat.; Keweenaw Co., O. A. Farwell. Rare.
61. **A. Trichomanes** L. Maidenhair Spleenwort. N. E., Winch. Cat.; Keweenaw Point; Isle Royale, Porter. Infrequent. N. & U. P.

ADIANTUM L.

*62. **A. pedatum** L. Maiden-hair Fern. Rich, moist woods. One of the most beautiful ferns. Common. Th.

PTERIDIUM Scop. PTERIS L. in part.

*63. **Pteridium aquilinum** (L.) Kuhn. Common Brake. *Pteris aquilina* L. Open ground. Common. Th.

CRYPTOGRAMMA R. Brown.

64. **C. acrostichoides** R. Br. American Rock-brake. Isle Royale, Gray's Manual; Caribou Island, Porter. U. P.
65. **C. Stelleri** (Gmel.) Prantl. Slender Cliff-brake. *Pellaea Stelleri* (Gmel.) Walt. Louse Isle, Winch. Cat.; Pictured Rocks, G. H. Hicks.

PELLAEA Link.

66. **P. atropurpurea** (L.) Link. Purple Cliff-brake. Norway, C. F. Wheeler. Shaded limestone rocks. N. E. Winch. Cat.

POLYPODIUM L.

*67. **P. vulgare** L. Common Polypody. Dry banks and rocks. Grand Ledge, W. J. B.; Hubbardston, C. F. Wheeler. Rarely seen in L. P., but very common in U. P.

EQUISETACEÆ Michx. Horsetail Family.

EQUISETUM L.

*68. E. arvense L. Common Horsetail. Damp sandy grounds. Common. Th.
69. E. arvense campestre Schultz. Keweenaw Co., O. A. Farwell.
70. E. arvense riparium Milde. Keweenaw Co., O. A. Farwell.
*71. E. fluviatile L. Swamp Horsetail. *E. limosum* L. In shallow water. Common. Th.
72. E. fluviatile polystachyon (Bruckner) Prayer. Keweenaw Co., O. A. Farwell.
*73. E. hyemale L. Scouring-Rush. Wet banks, common. Th.
*74. E. hyemale ramigerum A. Br. Keweenaw Co., O. A. Farwell.
75. E. laevigatum A. Br. Smooth Scouring-rush. Port Huron, C. K. Dodge; Manistee, F. P. Daniels.
76. E. littorale Kuehl. Shore Horsetail. New Buffalo; Oscoda; Keweenaw Co., O. A. Farwell.
77. E. palustre L. Marsh Horsetail. Lake Huron to the Arctic Sea. (Hook, Fl.) U. P.
*78. E. pratense Ehrh. Thicket Horsetail. Macomb Co.; Flint; to Pine Lake, Emmet Co., Winch. Cat.; Keweenaw Co., O. A. Farwell. Th.
*79. E. robustum A. Br. Stout Scouring-rush. Port Huron, C. K. Dodge; Morenci, W. J. B.; Manistee, F. P. Daniels.
80. E. scirpoides Michx. Sedge-like Equisetum. Macomb Co.; Flint; Hubbardston; Petoskey; to L. Superior, Whitney Cat., O. A. Farwell. Th.
*81. E. sylvaticum L. Wood Horse-tail. Ann Arbor, rare, Allmend. Cat.; Clinton Co.; Montcalm Co.; Flint; and northward where it is common. Th.
82. E. variegatum Schleich. Variegated Equisetum. S. E., Winch. Cat.; Hubbardston; Muir; Macomb Co.; Flint; sand dunes at the head of Little Traverse Bay; Drummond's I., Port Huron, C. K. Dodge; Detroit and Keweenaw Co., O. A. Farwell. Infrequent. Th.

LYCOPODIACEÆ Michx. Club-Moss Family.

LYCOPODIUM L.

83. L. alpinum L. Alpine Club-moss. Keweenaw Co., O. A. Farwell.
84. L. annotinum L. Stiff Club-moss. Woods. Petoskey to L. Superior; St. Clair Co., C. K. Dodge. Common.
85. L. Chamaecyparissus A. B. *L. complanatum Chamaecyparissus* D. C. Eaton. Tp. of Arthur, Clare Co., May 15, 1849, G. H. Cannon; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.
*86. L. clavatum L. Common Club-moss. Dry woods. Common. Th. N. & U. P.
87. L. clavatum monostachyon Hook. Keweenaw Co., O. A. Farwell.
*88. L. complanatum L. Ground-Pine. Bangor, Van Buren Co., Bailey; shore of Pine Lake; Keweenaw Co., O. A. Farwell; Woodward Lake, Ionia Co.; Flint; Macomb Co., Stanton, and northward. Th.
89. L. inundatum L. Bog Club-moss. Drummond's I.; Willow River, Huron Co.; Sugar Is., Winch. Cat.; Keweenaw Co., O. A. Farwell. Th.
*90. L. lucidulum Michx. Shining Club-moss. Moist woods. Frequent. Th.
*91. L. obscurum L. Ground Pine. Moist woods.
92. L. obscurum dendroideum D. C. Eaton. Macomb Co., Cooley; Keweenaw Co., O. A. Farwell, near Port Huron, C. K. Dodge; Oscoda.
93. L. porophilum Lloyd & Underw. Keweenaw Co., O. A. Farwell.
94. L. sabinaefolium Willd. Cedar-like Club-Moss. Keweenaw Co., O. A. Farwell. Rare.
95. L. Selago L. Fir Club-moss. Lake Superior, Gray's Manual; Keweenaw Co., O. A. Farwell. Infrequent U. P.

SELAGINELLACEÆ Underw.

SELAGINELLA Beauv.

*96. S. apus (L.) Spring. Creeping Selaginella. Ann Arbor, Allmendinger Cat.; Hubbardston, Grand Ledge, C. F. Wheeler; Orion, O. A. Farwell; Port Huron, W. S. Cooper and C. K. Dodge; Alma and Ann Arbor, C. A. Davis. Infrequent.

*97. **S. rupestris** (L.) Spring. Rock Selaginella. Flint; Woodward Lake; rare in L. P.; but common in U. P. Park Lake, Clinton Co., C. F. Wheeler; Oscoda, Grayling, Harrison, W. J. B.; Keweenaw Co., O. A. Farwell. Th.

98. **S. selaginoides** (L.) Link. Low Selaginella. *S. spinosa* Beauv. Isle Royale, Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell. U. P.

ISOETACEÆ Underw. Quillwort Family.

ISOETES L.

99. **L. echinospora Braunii** (Durieu) Engelm. Braun's Quillwort. Gray's Manual.

100. **L. lacustris** L. Lake Quillwort. River St. Marie, head of ship canal, T. C. Porter; St. Clair River, W. S. Cooper.

PINACEÆ Lindl. Coniferæ in part. Pine Family.

PINUS L.

101. **P. divaricata** (Ait.) Gord. Gray Pine. Jack Pine. *P. Banksiana* Lambert In the western part of the state noticed as far south as Grand Haven. Occurs at south end of Lake Michigan in Indiana; Sand Pt., Port Austin, Saginaw Bay, and northward along the shore of L. Huron, not common, Winch. Cat. In the central part of the State this pine is first seen in the northern part of Clare Co., where it is common in groves on sandy barrens. Trees sometimes grow 50 to 70 feet in height and rarely have been measured with a diameter of two feet.

102. **P. resinosa** Ait. Red Pine. Norway Pine. Dry woods. First noticed in Isabella Co., in center of the L. P.; very abundant in Clare Co., and northward. "Frequent on low, sandy plains in U. P., where it forms orchard-like groves," Whitney. Usually 100 to 110 feet high. On the east side of the State it extends southward to Port Huron, C. K. Dodge; Gratiot Co., C. A. Davis.

*103. **P. Strobus** L. White Pine. Weymouth Pine. C. & N. W.

LARIX Adans.

*104. **P. laricina** (DuRoi) Koch. American Larch. Tamarack. *L. Americana* Michx. Swamps. A slender tree southward, but sometimes reaching 100 feet in height northward, where it is abundant. Th.

PICEA Link.

105. **P. brevifolia** Peck. Keweenaw Co., O. A. Farwell.

106. **P. Canadensis** (Mill.) B. S. P. White Spruce. *P. alba* Link. From Ludington to Alcona Co., W. J. B.; Bay Co., G. M. Bradford; Petoskey and northward. N. & U. P. Common.

*107. **P. Mariana** (Mill.) B. S. P. Black Spruce. *P. nigra* Link. Frequent northward, and occasional south—a small tree in spagnous swamps. Th.

TSUGA Carriere.

*108. **T. Canadensis** (L.) Carriere. Hemlock. Grand Ledge. Rarely seen south of latitude 43° except in the west, and scarce on the Huron shore, but common on the east shore of Lake Michigan; Berrien Co., H. S. Pepoon, and from the central part of the State northward. Very abundant and of great size in Emmet Co. Th. except in S. E.

ABIES Juss.

109. **A. balsamea** (L.) Miller. Balsam or Balm-of-Gilead Fir. Frequent in the northern part of Clare Co.; Bay Co., G. M. Bradford; abundant at Petoskey, and northward. N. C. & U. P.

THUJA L. THUYA.

110. **T. occidentalis** L. Arbor Vitae. White Cedar. Lake Orion, Whitmore Lake; C. A. Davis; Montcalm Co., and northward.

JUNIPERUS L.

*111. **J. communis** L. Common Juniper. Occasional throughout, along the highest grounds.

112. **J. nana** Willd. *J. Sibirica* Burgsd. Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels; common in Jackson, Livingston and Washtenaw Counties, C. A. Davis.

113. **J. Sabina** L. Shrubby Red Cedar. *J. Sabina procumbens* Pursh. Little Traverse Bay, W. J. B.; Keweenaw Co., and Rochester, O. A. Farwell. N. & U. P.

*114. **J. Virginiana** L. Red Cedar. Savin. Bluffs and sterile soil. Throughout, but scarce.

TAXACEÆ Lindl. Yew Family.

TAXUS L.

115. **T. Canadensis** Marsh. American Yew. Ground Hemlock. *T. minor* (Michx.) Britton. Moist woods in the shade of evergreens. Along the east shore of Lake Michigan as far south as South Haven, L. H. Bailey; Macomb Co., where it is rare. St. Clair Co., C. K. Dodge. Common northward.

TYPHACEÆ J. St. Hil. Cat-tail Family.

TYPHA L.

116. **T. angustifolia** L. Narrow-leaved Cat-tail Flag. Detroit, Dr. A. B. Lyons; Port Huron, C. K. Dodge; Ann Arbor and Tuscola Co., C. A. Davis; Bay Co., G. M. Bradford; S. E. Rare.

*117. **T. latifolia** L. Common Cat-tail. Borders of streams and ponds. Common. Th.

SPARGANIACEÆ Agardh. Bur-Reed Family.

SPARGANIUM L.

118. **S. androcladum** (Engelm.) Morong. Branching Bur-reed. *S. simplex androcladum* Engelm. Ann Arbor, Allmendinger Cat.; Flint, Dr. Clark; Macomb Co.; St. Clair Co., C. K. Dodge; Bay Co., G. M. Bradford.

*119. **S. eurycarpum** Engelm. Broad Fruited Bur-reed. Borders of ponds. Frequent. C. & S.

120. **S. minimum** Fries. Small Bur-reed. Hubbardston; Manistee, E. J. Hill; Macomb Co.; Homestead, Benzie Co.; Keweenaw Co., O. A. Farwell. Rare.

*121. **S. simplex** Hudson. Simple-stemmed Bur-reed. Fruitport, E. J. Hill; Oscoda; Keweenaw Co., O. A. Farwell; Black River, B. & K. Common. Th.

122. **S. simplex angustifolium** (Michx.) Engelm. Isle Royale, Whitney Cat.; Keweenaw Co., O. A. Farwell; N. shore of Lake Superior, Agassiz.

NAIADACEÆ Lindl. Pondweed Family.

POTAMOGETON L.

123. **P. alpinus** Balbis. Northern Pondweed. *P. rufescens* Schrad. N. & U. P.

*124. **P. amplifolius** Tuckerman. Large-leaved Pondweed. Maple River; Macomb Co.; Pere Marquette River at Ludington, E. J. Hill; St. Clair Co., C. K. Dodge.

125. **P. diversifolius** Raf. Rafinesque's Pondweed. *P. hybridus* Michx. Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell.

126. **P. filiformis** Pers. Filiform Pondweed. Belle Isle, O. A. Farwell.

*127. **P. foliosus** Raf. Leafy Pondweed. *P. pauciflorus* Pursh. Hubbardston, Grand Rapids, Flint, Macomb Co., and northward. Typical forms occur at Manistee and Frankfort, E. J. Hill. Th.

128. **P. foliosus Niagarensis.** (Tuckerman) Morong. In running water, Hubbardston; Macomb Co., and along the great lakes.

*129. **P. Friesii** Ruprecht. Fries' Pondweed. *P. mucronatus* Schrad. Crooked River, Cheboygan Co., and common at Manistee and Frankfort, E. J. Hill; Oscoda, St. Mary's River, Sault de Ste Marie; Detroit, O. A. Farwell.

*130. **P. heterophyllus** Schreb. Various-leafed Pondweed. Th.

131. **P. heterophyllus graminifolius** (Fries) Morong. *P. gramineus graminifolius* Flint, Macomb Co.; St. Clair Co., C. K. Dodge, and northward.

132. **P. heterophyllus longipedunculatus** Morong. Woodward Lake, Ionia Co., Fries. Detroit, O. A. Farwell; Bear Lake, Van Buren Co., E. J. Hill; Black Lake, Cheboygan Co., B. & K.

133. **P. Hillii** Morong. Hill's Pondweed. Marquette Co., E. J. Hill; St. Clair Co., C. K. Dodge; Sturgis, F. P. Daniels.

134. **P. Illinoensis** Morong. Manistee, F. P. Daniels.

135. **P. interruptus** Kitaibel. Interrupted Pondweed. Manistee, E. J. Hill; Port Huron, C. K. Dodge.

136. **P. lateralis** Morong. Opposite-leafed Pondweed. Bear Lake, Van Buren Co., E. J. Hill; St. Clair Lake & River, C. K. Dodge. Rare.

*137. **P. lonchites** Tuckerman. Long-leafed Pondweed. *P. fluitans* Roth. Hubbardston; Macomb Co.; Detroit River, D. H. Campbell; Portage Lake, Crawford Co.; Manistee, F. P. Daniels. Infrequent. L. P.

*138. **P. lucens** L. Shining Pondweed. Muskegon River, near Houghton Lake; Flint; S. Mich., Wright Cat.; Detroit River, D. H. Campbell; Lake Superior, Agassiz. Th.

139. **P. marinus** L. Crystal Lake near Frankfort, Benzie Co., E. J. Hill; St. Clair Co., C. K. Dodge.

*140. **P. natans** L. Common Floating Pondweed. Ponds. Frequent. Th.

141. **P. Nuttallii** Cham. & Sch. *P. Pennsylvanicus* Cham. Ionia Co.; Macomb Co., Dr. D. Cooley; Fruitport, E. J. Hill; Keweenaw Co., O. A. Farwell. Th.

142. **P. obtusifolius** Mertens & Koch. Blunt-leafed Pondweed. "Floating in Gratiot Lake, N. Mich." Gray's Manual. St. Clair Co., J. W. Stacey.

*143. **P. pectinatus** L. Fennel-leafed Pondweed. Frequent. Th.

*144. **P. perfoliatus** L. Clasping-leafed Pondweed. Detroit, O. A. Farwell; Ingham Co., C. F. Wheeler, and northward. Common.

146. **P. perfoliatus Richardsonii** A. Bennett. *P. perfolatus lanceolatus* Robbins. Detroit, O. A. Farwell; Bay Co., G. M. Bradford.

*147. **P. praelongus** Wulfen. White-stemmed Pondweed. Maple River; Pine Lake, Ingham Co.; Black Lake, Cheboygan Co. Common. Th.

148. **P. pusillus** L. Small Pondweed. Manistee Lake, E. J. Hill; Detroit River, D. H. Campbell; Manistee, F. P. Daniels; St. Clair Lake and River, C. K. Dodge.

*149. **P. Robbinsii** Oakes. Robbins' Pondweed. North shore of Lake Superior; Pine Lake, seven miles N. E. of the Agricultural College, the only station known in the L. P., C. F. Wheeler.

151. **P. rutilis** Wolfg. Slender Pondweed. Detroit River, between Peche Isle and Belle Isle, C. F. Wheeler; Round Lake, near Jackson; St. Clair Lake & River, C. K. Dodge.

152. **P. spathulaeformis** (Robbins) Morong. Spatulate-leafed Pondweed. New Baltimore, Lake St. Clair, A. J. Pieters, J. W. Stacey.

153. **P. Spirillus** Tuckerman. Spiral Pondweed. "Lake Superior," A. Gray's Manual; Keweenaw Co., O. A. Farwell; St. Clair Lake and River, C. K. Dodge.

154. **P. Vaseyi** Robbins. St. Clair Lake and River, C. K. Dodge; Algonac, W. S. Cooper.

*155. **P. Zizii** Roth. Ziz's Pondweed. *P. angustifolius* Berch & Presl. Crystal Lake, near Frankfort; Bear Lake, Manistee Co., E. J. Hill; Crystal Lake, Montcalm Co.; Woodward Lake, Ionia Co.; Detroit River, D. H. Campbell. Infrequent.

*156. **P. zosteraefolius** Schum. Eel-grass. Pondweed. Common. Th.

ZANNICHELLIA L.

157. **Z. palustris** L. Zannichellia. Dr. A. B. Lyons, Detroit; Bay City, G. M. Bradford. Rare.

NAIAS L.

*158. **N. flexilis** (Willd.) Rost. & Schmidt. Slender Naias. Ponds. Frequent. Th.

*159. **N. flexilis robusta** Morong. South Haven, Park Lake, Clinton Co., Bailey; St. Clair Co., C. K. Dodge.

160. **N. marina** L. Large Naias. Flint, Dr. D. Clark.

SCHEUCHZERIACEÆ Agardh. Arrow-Grass Family.

TRIGLOCHIN L.

161. T. maritima L. Seaside Arrow-grass. Shores of Great Lakes; borders of deer licks in interior; Macomb Co.; S. Mich., Wright Cat.; Hubbardston, Petoskey, C. F. Wheeler; Algonac, W. S. Cooper.
162. T. palustris L. Marsh Arrow-grass. Marshes. Frequent. Th.

SCHEUCHZERIA L.

163. S. palustris L. S. W. Wright Cat.; Macomb Co., Cooley; Hubbardston; Montcalm Co.; Keweenaw Co., O. A. Farwell. Infrequent.

ALISMACEÆ D C. Water-Plantain Family.

ALISMA L. Water-Plantain.

*164. A. plantago-aquatica L. Water Plantain. Shallow water. Common. Th.
165. A. tenellum Mart. Dwarf Water Plantain. *Echinodorus parvulus* Engelm. A. B. Lyons; Gray's Manual, 6th edition.

SAGITTARIA L.

*166. S. arifolia Nutt. Arum-leaved Arrow-head. Alma, C. A. Davis; St. Clair Co., C. K. Dodge; Belle Isle, O. A. Farwell.
167. S. cristata Engelm. Crested Arrow-head. St. Clair Co., and Sarnia, C. K. Dodge.
*168. S. graminea Michx. Grass-leaved Sagittaria. Dr. A. B. Lyons, Detroit; Park Lake, Clinton Co., L. H. Bailey; Belle Isle, O. A. Farwell. S.
*169. S. heterophylla Pursh. Elk Rapids, Winch. Cat.; Detroit, D. H. Campbell; Alma, Chas. A. Davis. Th.
*170. S. latifolia Willd. Broad-leaved Arrow-head. Wet places. Th. *S. variabilis* Engelm.
171. S. rigida Pursh. *S. heterophylla rigida* Engelm. Fruitport, E. J. Hill; Great Lakes.

VALLISNERIACEÆ Dumort. Tape-Grass Family

PHILOTRIA Raf. (Elodea Michx.)

*172. P. Canadensis (Michx.) Britton. Water-weed. *Elodea Canadensis* Michx. Slow streams. Common. Th.

VALLISNERIA L.

*173. V. spiralis L. Tape-grass. Eel-grass. Ann Arbor, Winch. Cat.; S. Haven, Bailey; Hubbardston, to Petoskey; Lake Superior, Agassiz. Slow streams. Common in Grand River and tributaries. Th.

GRAMINEÆ Juss. Grass Family.

ANDROPOGON L.

*174. A. furcatus Muhl. Forked Beard-grass. Light soil. Common. Th.
*175. A. scoparius Michx. Broom Beard-grass. Sterile soil. Frequent, L. P.
176. A. scoparius multiramea Hack. Manistee, F. P. Daniels.

SORGHASTRUM Nash. Chrysopogon Benth. Not Trin.

*177. S. avenaceum (Michx.) Nash. Indian Grass. *Chrysopogon avenaceus* Benth. Dry banks and sandy fields. Variable. Infrequent. C. & S.

PASPALUM L.

178. **P. laeve** Michx. S. W. H. S. Pepoon. Rare.
179. **P. Muhlenbergii** Nash. Detroit, O. A. Farwell.
*180. **P. setaceum** Michx. Detroit, O. A. Farwell.

SYNTHERISMA Walt. PANICUM L. in part.

*181. **S. linearis** (Krock.) Nash. Small Crab-grass. *Panicum glabrum* Gaudin. Waste places. Common.
*182. **S. sanguinalis** (L.) Dulac. Large Crab-grass. *Panicum sanguinale* L. Waste places, gardens and fields. A bad weed, difficult to dig up or pull out; grows quickly and is perhaps the worst weed we have in gardens, at least in some localities. S. linearis grows in the same situations but is smaller and easily eradicated. Th.

ECHINOCHLOA Beauv. PANICUM L. in part.

*183. **E. Crus-galli** (L.) Beauv. Barnyard-grass. *Panicum Crus-galli* L. Low grounds. Variable. Common.
*184. **E. Walteri** (Pursh.) Nash. Salt-marsh Cockspur Grass. *P. Crus-galli hispidum* Ell. Low river bank near Hubbardston where it appears to be indigenous, C. F. Wheeler. Common along streams. L. P.

PANICUM L.

185. **P. boreale** Nash. Northern Panicum. Grand Rapids, Miss E. J. Cole; Traverse City, C. F. Wheeler; Keweenaw Co., O. A. Farwell.
*186. **P. capillare** L. Old-witch Grass. Sandy soil, fields. The spreading panicle is easily broken off and blown about by the wind. Common. Th.
*187. **P. clandestinum** L. Hispid Panicum. Low grounds. Macomb Co.; Flint, Hubbardston; Bay Co., G. M. Bradford. Rare.
*188. **P. Columbianum** Scribn. Belle Isle, O. A. Farwell.
*189. **P. commutatum** Schultes. Variable Panicum. Detroit, O. A. Farwell; St. Clair Co., J. W. Stacey. Dry woods.
*190. **P. depauperatum** Muhl. Capac, W. S. Cooper. Starved Panicum. Dry woods and barrens. Common. Th.
*191. **P. dichotomum** L. Forked Panicum. Dry or low grounds. A very common and exceedingly variable grass. Some forms seem distinct enough to be considered species. The most common forms are:
*192. **P. dichotomum commune** S. Wats.
*193. **P. dichotomum fasciculatum** S. Wats.
*194. **P. dichotomum gracile** S. Wats. Th.
195. **P. agrostoides** Muhl. Long Panicum. Specimen in the College Herb., collected by Dr. Cooley, at Washington, Macomb Co. Only locality known in the State.
196. **P. flexile** (Gattinger) Scrib. Wiry Panicum. Detroit, O. A. Farwell; Port Huron, C. K. Dodge; Manchester, C. F. Wheeler.
*196a. **P. macrocarpon** Le Conte. Detroit, O. A. Farwell.
*197. **P. implicatum** Scribn. Keweenaw Co., O. A. Farwell.
*198. **P. maculatum** Ashe. "Formerly included in P. dichotomum." St. Clair Co., C. K. Dodge.
199. **P. polyanthes** Schul. Small-fruited Panicum. *P. microcarpon* Muhl. Washington, Macomb Co., Dr. Cooley.
200. **P. miliaceum** L. Millet. Detroit and Keweenaw Co., O. A. Farwell.
201. **P. nitidum** Lam. Shining Panicum. Washington, Macomb Co., Dr. Cooley; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.
202. **P. proliferum** Lam. Manistee, F. P. Daniels.
*203. **P. Porterianum** Nash. Porters Panicum. *P. latifolium* Walt. Rich woods. Northward to Oscoda Co. Common. L. P.
*204. **P. pubescens** Lam. Hairy Panicum. Common. C. & S.
*205. **P. Scribnerianum** Nash. Scribner's Panicum. *P. scoparium* S. Wats. Not Lam. Hubbardston. Along the R. R. between St. Johns and Muir, northward to Baldwin; Bay Co., G. M. Bradford; Detroit, O. A. Farwell. Frequent in light sandy soil. Th.
*206. **P. sphaerocarpon** Ell. Round-fruited Panicum. *P. microcarpon sphaero-*

carpon (Ell.) Beal. Jackson, S. H. Camp; Detroit, O. A. Farwell: St. Clair Co., J. W. Stacey; Bay Co., G. M. Bradford.

*207. **P. virgatum** L. Tall Smooth Panicum. S. Mich., Wright Cat.; Ionia, Flint; Sturgis, F. P. Daniels. A tall coarse grass along rivers. Infrequent. Th.

208. **P. xanthophysum** A. Gray. Slender Panicum. N. & U. P. Grand Traverse Co., Indian River and Black Lake; Cheboygan Co., C. F. Wheeler; Alma, C. A. Davis; Manistee, F. P. Daniels; Northward to Keweenaw Co., O. A. Farwell.

CHAETOCHLOA Scribn. SETARIA Beauv.

*209. **C. glauca** (L.) Scrib. Yellow Foxtail. *Setaria glauca* Beauv. Cultivated Fields. Common. Th.

*210. **C. Italica** (L.) Scrib. Hungarian Grass, Italian or German Millet. *Setaria Italica* R. & S. Persisting after cultivation.

211. **C. verticillata** (L.) Scribn. *Setaria verticillata* Beauv. Ypsilanti, O. A. Farwell.

*212. **C. viridis** (L.) Scrib. Green Foxtail. *Setaria viridis* Beauv. Cultivated fields. Common. Th.

CENCHRUS L.

*213. **C. tribuloides** L. Sand-bur. Bur-grass. This bad weed has begun to occupy the S. part of the State, as far north as Bay City. Not as yet troublesome in fields, but likely to become so on sandy farms.

ZIZANIA L.

214. **Z. aquatica** L. Indian Rice. Water Oats. Borders of large streams and lakes. Yields an edible grain, gathered by the Indians, and greedily eaten by wild ducks which haunt lakes and rivers during its ripening in innumerable numbers. Th.

HOMALOCENCHRUS Mieg. (LEERSIA Sw.)

*215. **H. oryzoides** (L.) Poll. Rice Cut-grass. *L. oryzoides* Sm. Ditches and wet lands. Frequent. Th.

*216. **H. Virginicus** (Willd.) Britton. White Grass. *L. Virginica* Willd. Wet woods and river banks. Th.

PHALARIS L.

*217. **P. arundinacea** L. Reed Canary-grass. Borders of streams. "var. picta, the leaves striped with white, is the familiar ribbon-grass of the garden," Gray's Manual. Ann Arbor, Prof. M. W. Harrington; S. Mich., Winch. Cat.; Macomb Co.; Flint; Hubbardston; northward to L. Superior, Whitney Cat. Th.

218. **P. Canariensis** L. Canary-grass. Occasionally found in waste places.

ANTHOXANTHUM L.

*219. **A. odoratum** L. Sweet Vernal-grass. Ionia; Grand Rapids, Coleman Cat.; well established in the College lawn. Rare.

SAVASTANA Schrank. HIEROCHLOE Gmel.

220. **S. odorata** (L.) Scribn. Holy Grass. *Hierochloe borealis* R. & S. Not confined to the shores of the Great Lakes; rarely found in the central part of the State. Ionia, Hubbardston, C. F. Wheeler; Macomb Co.; Flint; S. E., Winch. Cat.; Ann Arbor, C. A. Davis. More common northward. Th.

ARISTIDA L.

221. **A. gracilis** Ell. Slender Aristida. Port Huron, C. K. Dodge; near Ann Arbor, C. A. Davis.

222. **A. purpurascens** Poir. Sturgis, F. P. Daniels.

STIPA L. Feather-grass.

223. **S. avenacea** L. Black Oat-grass. S. W., Wright Cat.; South Haven, Bailey; Baldwin; Dundee; Cass Co.; Point Aux Pins, Macoun Can. Cat. Infrequent. Th.
*224. **S. spartea** Trin. Porcupine-grass. Dry plains. S. Mich., Wright Cat.; Macomb Co.; shore of Woodward Lake, Ionia Co.; hills along Grand River near Ionia; Ann Arbor, Tuscola Co., C. A. Davis.

ORYZOPSIS Michx.

*225. **O. asperifolia** Michx. White-grained Mountain Rice. Hillsides. Common.
226. **O. juncea** (Michx.) B. S. P. Slender Mountain Rice. *O. Canadensis* Torr. Sterile soil. S. E., Wright Cat.; Hubbardston; Montcalm Co., C. A. Davis; Macomb Co.; common in Clare Co.; frequent from Ionia northward. Th.
*227. **O. melanocarpa** Muhl. Black-fruited Mountain Rice. Woods. S. Mich., Wright Cat.; S. Haven; Macomb Co.; Flint; Hubbardston. Infrequent. C. & S.

MILIUM L.

*228. **M. effusum** L. Tall Millet-grass. Woods. Frequent. Th.

MUHLENBERGIA Schreber.

*229. **M. diffusa** Willd. Nimble Will. Open woods, becoming frequent around dwellings. S. Mich., Wright Cat.; So. Haven, Bailey; Flint; Hubbardston; C. F. Wheeler; Ann Arbor, C. A. Davis. C. & S.
*230. **M. Mexicana** (L.) Trin. Meadow Muhlenbergia. Low grounds. Variable. Frequent. Th.
*231. **M. racemosa** (Michx.) B. S. P. Marsh Muhlenbergia. *M. glomerata* Trin. Marshes. Infrequent. Th.
*232. **M. sylvatica** Torr. Wood Muhlenbergia. Hubbardston; Flint; Lake Superior, Agassiz. Frequent. Th.
*233. **M. tenuiflora** (Willd.) B. S. P. Slender Muhlenbergia. *M. Willdenovii* Trin. Flint; Macomb Co.; S. Mich., Wright Cat.; Muskegon, C. F. Wheeler. Rare. C. S.

BRACHYELYTRUM Beauv.

*234. **B. erectum** (Schreb.) Beauv. *B. aristatum* Beauv. Woods. Frequent.

PHLEUM L.

235. **P. alpinum** L. Mountain Timothy. L. Superior, Whitney Cat.; Keweenaw Co., O. A. Farwell.
*236. **P. pratense** L. Timothy. Herd's-Grass. Meadows everywhere.

ALOPECURUS L.

*237. **A. geniculatus** L. Marsh Foxtail. *A. geniculatus aristulatus* Torr. S. Mich., Wright Cat.; Macomb Co.; Bay Co., G. M. Bradford. Th.
*238. **A. pratensis** L. Meadow Foxtail. Cultivated from Europe and escaped.

SPOROBOLUS R. Br.

239. **S. brevifolius** (Nutt.) Nash. Keweenaw Co., O. A. Farwell.
240. **S. cryptandrus** (Torr.) A. Gray. Sand Dropseed. S. Mich., Winch. Cat.; Point Edward, River St. Clair, Macoun; Bay City, W. J. B.; shore of Gull Lake, Augusta, Kalamazoo Co. Infrequent. C. & S.
*241. **S. neglectus** Nash. Small Rush-grass. Frequent. Lansing, Saugatuck, C. F. Wheeler; Detroit, O. A. Farwell.
242. **S. serotinus** (Torr.) A. Gray. Late-flowered Dropseed. Sandy wet places, Gray's Manual; Keweenaw Co., O. A. Farwell. Rare.
*243. **S. vaginaeflorus** (Torr.) Wood. Sheathed Rush-grass. Flint; Detroit, Dr. A. B. Lyons; Ann Arbor, C. A. Davis. Rare. C. & S.

CINNA L.

*244. **C. arundinacea** L. Low grounds. Frequent.
*245. **C. latifolia** (Trev.) Griseb. Slender Wood Reed-grass. *C. pendula* Trin. Wet woods throughout.

AGROSTIS L.

*246. A. alba L. Fiorin or White Bent-grass. Red Top. *A. alba vulgaris* Thurber. Naturalized from Europe. A common pasture and meadow grass.
*247. A. alba stolonifera (L.) Vasey. Detroit, O. A. Farwell.
*248. A. canina L. Brown Bent-grass. Ann Arbor, Winch. Cat., Ronald, Ionia Co. Infrequent.
*249. A. coarctata Ehrh. Detroit, O. A. Farwell.
*250. A. hyemalis (Walt.) B. S. P. Rough Hair-grass. *A. scabra* Willd. Marshes and sterile soil. Common. Th.
*251. A. perennans (Walt.) Tuckerman. Thin-grass. Swamps and damp woods. S. Mich., Wright; Macomb Co.; Hubbardston. Infrequent.
*252. A. pseudo-intermedia O. A. Farwell. New name for *A. intermedia* Scribn. Detroit, O. A. Farwell.

CALAMAGROSTIS Adans.

*253. C. Canadensis (Michx.) Beauv. Blue-Joint. Common.
254. C. confinis (Willd.) Nutt. Bog Reed-grass. *C. Lapponica* Trin. Isle Royale, Lake Superior, T. C. Porter; Sturgis, F. P. Daniels.
255. C. Langsdorfii (Link.) Trin. Langsdorf's Reed-grass. Isle Royale, T. C. Porter.
256. C. neglecta (Ehrh.) Gaertn. Narrow Reed-grass. *C. stricta* Beauv. Flint, D. Clark; S. W., H. S. Pepoon; and northward to Lake Superior, A. Gray. Rare.

AMMOPHILA Host.

257. A. arenaria (L.) Link. Sea Sand-reed. N. & U. P. *A. arundinacea* Host. This is one of the few plants found both by the ocean and the shores of the Great Lakes, Petoskey; Point au Chene, Winch. Cat.; shores of Lake Huron, C. K. Dodge. Infrequent.

CALAMOVILFA Hack.

258. C. longifolia (Hook.) Hack. Long-leaved Reed-grass. *Calamagrostis longifolia* Hook. Sand dunes along L. Michigan. S. Haven, Bailey; Petoskey; Point au Chene, Winch. Cat.; Oscoda. Th.

APERA Adans.

*259. A. Spica-venti L. Beauv. College lawn.

DESCHAMPSIA Beauv.

*260. D. caespitosa (L.) Beauv. Tufted Hair-grass. In bogs. Frequent. Th.
261. D. flexuosa (L.) Trin. Common Hair-grass. Oscoda; Baldwin, to Lake Superior; Keweenaw Co., O. A. Farwell.

TRISETUM Pers.

262. T. subspicatum (L.) Beauv. Narrow False-oat. *T. subspicatum molle* A. Gray. Marquette, E. J. Hill; Whitney's Cat. Common. U. P.

AVENA L.

263. A. Smithii Porter. Smith's Oat. *Melica Smithii* Vasey. Keweenaw Point; Isle Royale, Dr. Robbins, in Gray's Man.; woods near Sault Ste. Marie, C. E. Smith; shore of Crystal Lake, Benzie Co., L. H. Dewey; Vanderbilt, Otsego Co.; Keweenaw Co., O. A. Farwell.
*264. A. striata Michx. Oat Grass. Woods. Infrequent.

ARRHENATHERUM Beauv.

*265. A. elatius (L.) Beauv. Tall Oat-grass. *A. avenaceum* Beauv. Bay Co., Macomb Co. Escaped from cultivation.

DANTHONIA DC.

266. D. intermedia Vasey. Keweenaw Co., O. A. Farwell.
*267. D. spicata (L.) Beauv. Wild Oat-grass. Sterile soil. Frequent. Th.

CAPRIOLA Adans. CYNODON Rich.

*268. **C. Dactylon** (L.) Kuntze. Bermuda-grass. Near the depot of the Chicago and Grand Trunk R. R. in Lansing.

SPARTINA Schreb.

*269. **S. cynosuroides** (L.) Willd. Fresh-water Cord-grass. Banks of rivers, to N. Shore L. Superior, Agassiz. Tuscola and Washtenaw. Th.

ATHEROPOGON Muhl. BOUTELOUA Lagasca. in part.

270. **A. curtipendulus** (Michx.) Fourn. *Bouteloua racemosa* Lag. Dry plains. S. Mich., Wright Cat.; Macomb Co., on farm of L. D. Watkins, Manchester; Sturgis, F. P. Daniels.

ELEUSINE Gaertn.

*271. **E. Indica** (L.) Gaertn. Dog's-tail or Wire-grass. S. & C. Ionia Co.; South Haven, Bailey; S. Mich., Wright Cat. Infrequent. S. & C.

PHRAGMITES Trin.

*272. **P. Phragmites** (L.) Karst. Reed. *P. communis* Trin. Swamps. Infrequent. Th.

TRICUSPIS Beauv. TRIODIA R. Br., in part.

273. **T. seslerioides** (Michx.) Torr. Tall Red-top. *Triodia cuprea Jacq.* S. Mich., Wright's Cat. S. E.

TRIPLASIS Beauv. TRIODIA R. Br., in part.

274. **T. purpurea** (Walt.) Chapm. Sand-grass. Shore of Lake Erie, Monroe Co., C. F. Wheeler; shore of Lake Huron, C. K. Dodge.

ERAGROSTIS Beauv.

275. **E. capillaris** (L.) Nees. Capillary Eragrostis. Coleman's Cat.; S. Mich., Wright's Cat.; Ann Arbor, M. W. Harrington. Rare.

*276. **E. Eragrostis** (L.) Karst. Low Eragrostis. *Eragrostis minor* Host.

*277. **E. Frankii** Steud. Frank's Eragrostis. Roadsides in low ground. Hubbardston; Gratiot Co.; Grand Rapids; Detroit, O. A. Farwell. Frequent. C. & S.

*278. **E. hypnoides** (Lam.) B. S. P. Creeping Eragrostis. *E. reptans* Nees. Gravelly borders of streams. Common.

*279. **E. major** Host. Stink Grass. Waste places and gardens, a common weed. Th.

280. **E. pectinacea** (Michx.) Steud. Purple Eragrostis. *E. pectinacea spectabilis* A. Gray. Dry sandy ground. S. Mich., Wright Cat. Reaches its northern limits at Howard City. Infrequent. C. & S.

281. **E. pilosa** (L.) Beauv. Tufted Eragrostis. Grand Rapids, Coleman's Cat.; Macomb Co.; Detroit, O. A. Farwell; S. W., H. S. Pepoon.

282. **E. Purshii** Schrad. Pursh's Eragrostis. Norway, C. F. Wheeler; Rochester, W. A. Brotherton and J. W. Stacey; Detroit, O. A. Farwell; Bay Co., G. M. Bradford. I see no way of distinguishing this species from E. pilosa (L.) Beauv. and believe them to be the same.

EATONIA Raf.

*283. **E. nitida** (Spreng.) Nash. Slender Eatonia. *E. Dudleyi* Vasey. Hubbardston, C. F. Wheeler; Orion, O. A. Farwell. Rare.

*284. **E. obtusata** (Michx.) A. Gray. Blunt-scaled Eatonia. S. E., Wright Cat.; Flint; Hubbardston, northward. Rare.

*285. **E. Pennsylvanica** (D C.) A. Gray. Moist woods. Common. Th.

KOELERIA Pers.

*286. **K. cristata** (L.) Pers. Dry hills. Frequent. Th.

KORYCARPUS Zea. DIARRHENA Raf.

*287. K. diandrus (Michx.) Kuntze. *Diarrhena American* Beauv. S. Mich., Wright Cat.; Flint; Hubbardston. Reaches its northern limits in Ionia Co. Rare.

BRIZA L.

288. B. media L. Quaking Grass. Bay City, G. M. Bradford, C. A. Davis.

CYNOSURUS L.

289. Cynosurus cristatus L. Dog's-tail Grass. Scarce.

DACTYLIS L.

*290. D. glomerata L. Cock's Foot. Orchard Grass. Escaped from cultivation and becoming frequent.

POA L.

291. P. alpina L. Alpine Spear-grass. U. P. Isle Royale, C. G. Loring, Jr., in Gray's Manual; Keweenaw Co., O. A. Farwell. U. P.

*292. P. alsodes A. Gray. Grove Meadow-grass. Banks of brooks, flowering early. Flint; Hubbardston; Inland, Grand Traverse Co., Infrequent. L. P.

*293. P. annua L. Low Spear-grass. Low grounds. Common. Th.

294. P. autumnalis Muhl. Flexuous Spear-grass. *P. flexuosa* Muhl. Swamps. Hubbardston; Constantine, C. F. Wheeler; Flint, Dr. Clark; Rochester, O. A. Farwell.

*295. P. compressa L. Wire-grass. Blue Grass (of N. Eng. and N. Y.). Dry fields. Common. Th.

*296. P. debilis Torr. Weak Spear-grass. Hillsides. S. Mich., Winch. Cat.; Macomb Co.; Hubbardston to N. Shore of Lake Superior, Macoun. Infrequent. Th.

*297. P. flava L. Fowl Meadow-grass. *P. serotina* Ehrh. Wet meadows, where it is a valuable grass, sometimes mistaken for Red-top, Agrostis alba. Th.

298. P. glauca Vahl. Glaucous Spear-grass. Near Grayling; Isle Royale; Keweenaw Co., O. A. Farwell.

300. P. nemoralis L. Wood Meadow-grass. *P. caesia strictoir* A. Gray. Throughout N. Mich. Infrequent except in the north.

*301. P. pratensis L. Kentucky Blue Grass. June Grass. Pastures and meadows.

302. P. sylvestris A. Gray. Sylvan Spear-grass. Low woods. S. Mich., Winch. Cat.; Flint; Hubbardston. Rare. C. & S.

303. P. trivialis L. Roughish Meadow-Grass. S. Mich., Wright Cat.; Flint. Sparingly in cultivation.

GRAPHEPHORUM Desv.

*304. G. melicoideum (Michx.) Beauv. River banks. Macomb Co.; Flint; Hubbardston; Petoskey; Grand Detour, Upper Michigan, Prof. Porter. Rare South, abundant at Pic River, Macoun. Th.

305. G. melicoides major A. Gray. Swamps. Hubbardston; Washington, Macomb Co.

PANICULARIA Fabr. GLYCERIA R. Br.

*306. P. Americana (Torr.) MacM. Tall Manna-grass. *Glyceria grandis* S. Wats. Common. Th.

*307. P. Canadensis (Michx.) Kuntze. Rattlesnake-grass. *Glyceria Canadensis* Trin. Borders of marshes. S. W., Winch. Cat.; Flint; Ionia Co. Infrequent. Th.

*308. P. fluitans (L.) Kuntze. Floating Manna-grass. *Glyceria fluitans* R. Br. Shallow water. Common. Th.

308a. P. laxa Scribn. Northern Manna-grass. Muskegon, W. J. B.; Keweenaw Co., O. A. Farwell.

*309. P. nervata (Willd.) Kuntze. Nerved Manna-grass. *Glyceria nervata* Trin. Very variable. Woods and wet meadows. Th.

*310. P. pallida (Torr.) Kuntze. Pale Manna-grass. *Glyceria pallida* Trin. Constantine, Wheeler; Keweenaw Co., O. A. Farwell; Manistee and Sturgis, F. P. Daniels. Wet places. Rare. S.

PUCCINELIA Parl.

311. P. airoides (Nutt.) S. Wats. Slender Meadow-grass. Bay City, G. M. Bradford. Near salt works.

FESTUCA L.

*312. F. elatior L. Taller Meadow Fescue. *F. elatior pratensis* A. Gray. Meadows and roadsides.

*313. F. nutans Willd. Nodding Fescue-grass. Woods. Frequent. L. P.

*314. F. octoflora Walt. Slender Fescue-grass. *F. tenella* Willd. Dry grounds. Infrequent. Th.

*315. F. ovina L. Sheep's Fescue. Dry grounds. Common. Very variable. Th.

*316. F. ovina capillata (Lam.) Hack. Hair-leaved Fescue. In lawns. Not uncommon.

317. F. ovina duriuscula (L.) Hack. Hard Fescue. S. Mich., Wright Cat.; Petoskey; Bay Co., G. M. Bradford; Keweenaw Co., Robbins; Isle Royale, Gillman. Sparingly in cultivation. Th.

*318. F. ovina marginata Hack. In lawns. Common.

319. F. rubra heterophylla Hack. Variable-leaved Fescue. Clifton, O. A. Farwell; Frankfort, W. J. B.; shores of Traverse Bay; Muskegon, C. F. Wheeler.

BROMUS L.

*320. B. asper Murr. Hairy Brome-grass. Gray's Manual.

321. B. breviaristatus Thurb. Short-awned Chess. First collected on low sand dunes near Bay View in August, 1879, by C. F. Wheeler. In June, 1881, Prof. V. M. Spalding also collected this species near Charlevoix. The farthest station east known for this grass.

322. B. brizaeformis Fisch & Mey. Quake-grass. Manistee, F. P. Daniels.

*323. B. ciliatus L. Fringed Brome-grass. *B. purgans* L. Frequent. Variable.

*324. B. hordeaceus L. Soft Chess. *B. mollis* L. Agricultural College, W. J. B.; Detroit, O. A. Farwell.

*325. B. inermis Leyss. Awnless Brome-grass. Sandy meadows. Spreading.

*326. B. Kalmii A. Gray. Wild Chess. Dry open woods. S. E., Wright's Cat.; Flint; Macomb Co.; Hubbardston; northward to Quinnessec, E. J. Hill. Infrequent.

327. B. racemosus L. Smooth Brome-grass. Detroit, O. A. Farwell; Alma, C. A. Davis. Th.

*328. B. secalinus L. Chess. Cheat. Too common in wheat fields.

328a. B. sterilis L. Barren Brome-grass. Bay City, G. M. Bradford.

*329. B. tectorum L. Downy Brome-grass. Grand Rapids. Spreading rapidly; Detroit, O. A. Farwell; Bay Co., G. M. Bradford.

LOLIUM L.

331. L. perenne L. Common Darnel. Ray or Rye-grass. Macomb Co., Dr. Cooley; Ionia Co.; Bay City, G. M. Bradford. Scarcely naturalized.

332. L. temulentum L. Bearded Darnel. Scarcely naturalized. Flint; Macomb Co.; S. Mich., Wright Cat.

AGROPYRON Gaertn.

*333. A. caninoides (Ramalay) Beal. Lansing, escaped from cultivation.

334. A. caninum (L.) R. & S. Awned Wheat-grass. Th. S. Mich., Winch. Cat.; Macomb Co.; Hubbardston; northward.

335. A. dasystachyum (Hook.) Vasey. Northern Wheat-grass. Common at Petoskey; N. W., Winch. Cat.; Oscoda and the sandy shores of the great lakes; Keweenaw Co., O. A. Farwell. N. & U. P.

336. A. occidentale Scribn. Occasional. Port Huron, C. K. Dodge.

337. A. pseudorepens S. and S. Shores of Grand Traverse Bay, C. F. Wheeler; St. Clair Co., C. K. Dodge; Keweenaw and Marquette counties, O. A. Farwell.

*338. A. repens (L.) Beauv. Quick-grass or Quack-grass. Cultivated grounds. Varies greatly. Sometimes grows to the exclusion of everything else, and is widespread enough to be considered a pest. Th.

339. A. Richardsoni Shreb. Bay View, W. J. B.; shore of Grand Traverse Bay, C. F. Wheeler; Keweenaw Co., O. A. Farwell.

340. A. spicatum (Pursh.) Scribn. & Small. Western Wheat-grass. Introduced into Bay City, G. M. Bradford; Keweenaw Co., Detroit, O. A. Farwell.
341. A. tenerum Vasey. Port Huron; along railroads; an advent from the west, C. K. Dodge.
342. A. violaceum (Hornem.) Vasey. Purplish Wheat-grass. Keweenaw Peninsula, Farwell; Lake Superior, Porter.

SECALE L.

*343. S. cereale L. Rye. Escaped from cultivation.

HORDEUM L.

*344. H. jubatum L. Squirrel-tail Grass. Sands. N. shore of Lake Superior, Agassiz; Sault de Ste. Marie, R. Bell; Bay City. Infrequent. Th.
345. H. nodosum L. Detroit, O. A. Farwell. Occasional.

ELYMUS L.

*346. E. Canadensis L. Nodding Wild Rye. *E. Canadensis glaucifolius* A. Gray. River banks. Common. Th.
347. E. glaucus Buckl. Smooth Wild Rye. S. W., H. S. Pepoon. Britton and Brown. *E. Sibiricus Americanus* S. Wats. & Coul. Marquette, Porter in Gray's Manual; Keweenaw Co., O. A. Farwell.
348. E. mollis Trin. Smooth Wild Rye. Shores of the Great Lakes, Gray's Manual; north shore of Lake Superior, Agassiz.
*349. E. robustus Scribn. & Sm. Muskegon, C. D. McLouth; Lansing, W. J. B.
*351. E. striatus Willd. Slender Wild Rye. *E. striatus villosus* A. Gray. S. Mich., Wright Cat.; Flint; Hubbardston; Manistee, F. P. Daniels; northward to L. Superior. Th.
*352. E. Virginicus L. Virginia Wild Rye. River banks. Common. Th.
*353. E. Virginicus glaucus Beal. Grand River Valley, with the species. W. J. B.

HYSTRIX Moench. ASPRELLA Willd.

*354. Hystrix Hystrix (L.) Millsp. Bottle-Brush grass. Th. *Asprella Hystrix* Willd. Moist woods. A variety of this grass is found in one locality near Hubbardston with smooth and very glaucous culms, leaves rough, hairy.

CYPERACEÆ J. St. Hil. Sedge Family.

CYPERUS L.

*356. C. diandrus Torr. Low Cyperus. Low grounds. Common. C. & S.
358. C. Engelmanni Steud. Englemann's Cyperus. Fruitport, E. J. Hill; shore of Park Lake, Clinton Co., C. F. Wheeler; St. Clair Co., C. K. Dodge. Rare.
*359. C. erythrorhizos Muhl. Red-rooted Cyperus. Macomb Co., D. Cooley; Bay City, G. M. Bradford. Infrequent.
*360. C. esculentus L. Yellow Nutt-grass. A troublesome weed on low grounds, spreading rapidly by means of its nut-like tubers. Hard to eradicate. Muir; Flint; Grand Rapids; Detroit; north to Oscoda. Frequent. L. P.
361. C. esculentus angustispicatus Britton. Detroit, A. O. Farwell.
*362. C. filiculmis Vahl. Slender Cyperus. Sterile soil. Common. C. & S.
363. C. flavescens L. Yellow Cyperus. Grand Rapids, Coleman Cat.; S. Mich., Wright Cat. Rare. S.
364. C. Houghtonii Torr. Houghton's Cyperus. Hilltops near Indian River, Wheeler; Long Lake, Cheboygan Co., B. & K. St. Clair., C. K. Dodge.
*365. C. inflexus Muhl. Awned Cyperus. *C. aristatus* Boeckl. Grand Rapids, Coleman; Ionia; banks of Cedar River, Agricultural College. Not common.
366. C. refractus Engelm. Detroit, O. A. Farwell.
*367. C. rivularis Kunth. Shining Cyperus. *C. diandrus castaneus* Torr. Frequent.
368. C. Schweinitzii Torr. Schweinitz's Cyperus. Lake Michigan shore at South Haven, L. H. Bailey; Kalamazoo, Tuthill; Manistee, F. P. Daniels, S. West, H. S. Pepoon.

369. C. speciosus Vahl. Michaux's Cyperus. Low grounds. Hubbardston; Flint.
*370. C. strigosus L. Straw-colored Cyperus. Low grounds. Common. C. & S.
371. C. strigosus capitatus Boeckl. Detroit, O. A. Farwell.
372. C. strigosus robustior Kunth. Detroit, O. A. Farwell.

KYLLINGA Rott.

374. K. pumila Michx. Low Kyllingia. Dr. Lyons. S.

DULICHIUM L. C. Richard.

*375. D. arundinaceum (L.) Britton. *D. spathaceum* Pers. Borders of swamps and ponds. Common. Th.

ELEOCHARIS R. Br.

*376. E. acicularis (L.) R. & S. Spike-rush. Alma, Washtenaw Co., C. A. Davis. Th.
377. E. acuminata (Muhl.) Nees. Flat-stemmed Spike-rush. Shores of lakes.
378. E. Engelmanni Steud. Engelmann's Spike-rush. Jackson, S. H. Camp; Detroit, O. A. Farwell.
*379. E. intermedia (Muhl.) Schultes. Matted Spike-rush. Macomb Co., Dr. D. Cooley; Grand Traverse Bay, Winch. Cat.; Hubbardston, C. F. Wheeler; Alma, C. A. Davis. Low river banks.
380. E. interstincta (Vahl.) R. & S. Knotted Spike-rush. *E. equisetoides* Torr. Wright Cat., Jackson Co., 1838.
*381. E. mutata (L.) R. & S. Quadrangular Spike-rush. *E. quadrangulata* R. & S. S. Mich., A. Gray; Flint; borders of Crystal Lake, Montcalm Co.; shores of Park Lake and Pine Lake; Algonac, W. S. Cooper. Infrequent. C. & S.
381a. E. obtusa Schults. Ovoid Spike-rush. Wet grounds. N. shore of L. Superior, Agassiz; southward; St. Clair Co., C. K. Dodge; Alma, Ann Arbor, C. A. Davis. Th.
*382. E. olivacea Torr. Bright-green Spike-rush. Shores of Park Lake, Clinton Co., Wheeler; Vestaburg, C. A. Davis.
*383. E. ovata (Roth.) R. & S. Keweenaw Co., O. A. Farwell.
*384. E. palustris (L.) R. & S. Creeking Spike-rush. Wet places. Alma, Ann Arbor, C. A. Davis; Bay Co., G. M. Bradford.
385. E. palustris calva A. Gray. Lake Antoine, E. J. Hill.
*386. E. palustris glaucescens (Willd.) A. Gray. Alma, C. A. Davis. Frequent.
*387. E. Robbinsii Oakes. Robbins' Spike-rush. Shallow water. Park Lake, Clinton Co. The only station known in the State, C. F. Wheeler.
*388. E. palustris vigens L. H. Bailey. Indian River, Cheboygan Co.; along the Great Lakes, Gray's Man. Keweenaw Co., O. A. Farwell.
389. E. rostellata Torr. Beaked Spike-rush. Marshes. Hubbardston; Macomb Co., Drummond's I., Winch. Cat. Tuscola and Washtenaw Counties, C. A. Davis; Bay Co., G. M. Bradford. Rare.
390. E. tenuis (Willd.) Schultes. Slender Spike-rush. Oscoda; east coast of L. Superior, Canadian Cat.; Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis. Th.

PSILOCARYA Torr.

391. P. scirpoides Torr. Long-beaked Bald-rush. Shore of Crooked Lake, near Grand Rapids, Miss E. J. Cole.

STENOPHYLLUS Raf.

392. S. capillaris (L.) Britton. Hair-like Stenophyllus. *Fimbristylis capillaris* A. Gray. S. Mich., Wright; Detroit; St. Clair Co., C. K. Dodge; Algonac, W. S. Cooper. Rare.

FIMBRISTYLIS Vahl.

*393. F. autumnalis (L.) R. & S. Slender Fimbristylis. S. Mich., Wright; Pine Lake, Ingham Co., Manistee, F. P. Daniels; Vestaburg, C. A. Davis.
394. F. castanea (Michx.) Vahl. Marsh Fimbristylis. Port Huron, C. K. Dodge.

SCIRPUS L.

*395. S. Americanus Pers. Three-square. *S. pungens* Vahl. Borders of ponds, Alma, Ann Arbor, C. A. Davis. Common. Th.

*396. S. atrovirens Muhl. Dark green Bulrush. Alma, Ann Arbor, C. A. Davis. Wet meadows. Common.

397. S. atrovirens pallidus Britton. Introduced from the west into Bay Co., G. M. Bradford; Keweenaw Co., Detroit, O. A. Farwell.

398. S. caespitosus L. Tufted Club-rush. Dr. A. B. Lyons; Marquette, E. J. Hill; north shore of Lake Superior. Agassiz. U. P.

*399. S. Clintonii A. Gray. Clinton's Club-rush. Bluffs along Fish Creek, Hubbardston; Bath, L. H. Bailey; St. Clair Co., C. K. Dodge; Bay City, C. A. Davis. Rare. C.

*400. S. cyperinus (L.) Kunth. Wool-grass. Wats. & Coult. Alma, Ann Arbor, C. A. Davis. Frequent and variable.

401. S. cyperinus Eriophorum (Michx.) Britton. *Eriphorum cyperinum laxum.* Keweenaw Co., O. A. Farwell; Bay City, G. M. Bradford.

*402. S. debilis Pursh. Weak-stalked Club-rush. Macomb Co., Cooley; Park Lake, Clinton Co., Wheeler; St. Clair Co., C. K. Dodge; Manistee, F. P. Daniels; Alma, C. A. Davis. Rare.

403. S. Hallii A. Gray. Muskegon, C. D. McLouth.

404. S. fluviatilis (Torr.) A. Gray. River Club-rush. Margins of rivers, S. Mich., Winch. Cat.; Macomb Co.; Hubbardston; Detroit; abundant along Maple River; west of Lake Superior, Macoun. Th.

*405. S. lacustris L. Great Bulrush. In still water. Common. Th.

*406. S. lineatus Michx. Reddish Bulrush. Common in Bay Co., G. M. Bradford; S. W., H. S. Pepoon. River banks, S. Mich., Winch Cat.; Flint; Macomb Co.; Hubbardston; St. Clair Co., C. K. Dodge; Keweenaw Co.; Alma, Ann Arbor, C. A. Davis.

407. S. microcarpus Presl. Small-fruited Bulrush. *S. sylvaticus digynus* Boeckl. Lake Nipigon, Ont., Macoun; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.

408. S. nanus Spreng. Dwarf Club-rush. Hubbardston; Clinton Co., E. F. Smith. *Eleocharis pygmaea* Torr.

409. S. Olneyi A. Gray. Olney's Bulrush. Border of deer lick near Hubbardston, Wheeler.

410. S. pauciflorus Lightf. Few-flowered Club-rush. Grand Rapids, Miss E. J. Cole; Port Austin, C. A. Davis. Frequent northward.

411. S. polyphyllus Vahl. Leafy Bulrush. S. Mich., Wright Cat.

*412. S. Smithii A. Gray. Smith's Club-rush. Shore of Park Lake, C. F. Wheeler, 1891; Bay Co., G. M. Bradford; Manistee, F. P. Daniels.

*413. S. subterminalis Torr. Water Club-rush. Houghton Lake; Woodward Lake, Ionia Co.; Flint; Macomb Co.; S. Mich., Wright Cat.; north of Lake Superior. Can. Cat.; Alma, C. A. Davis. Infrequent.

413a. S. sylvaticus L. Wood Bulrush. Keweenaw Co., O. A. Farwell.

*414. S. Torreyi Olney. Torrey's Bulrush. Border of Pine Lake, Ingham Co., Bailey.

ERIOPHORUM L.

415. E. alpinum L. Alpine Cotton-grass. Mud Lake; Petoskey, E. J. Hill; Macomb Co., Cooley; Elk Rapids, W. S. Cooper; Keweenaw Co. Infrequent. Th.

416. E. gracile Koch. Slender Cotton-grass. S. Mich. Wright Cat.; Flint; Hubbardston; Montcalm Co., and northward; Kalamazoo, Tuthill; Ann Arbor, C. A. Davis. Rare. Th.

*418. E. polystachyon L. Tall Cotton-grass. Swamps. Common. Th.

*419. E. vaginatum L. Sheathed Cotton-grass. Sphagnous swamps. S. Mich., Winch. Cat.; Macomb Co.; St. Clair Co., C. K. Dodge; near Ann Arbor, C. A. Davis; Hubbardston; Bay Co., and northward. Th.

*420. E. Virginicum L. Virginia Cotton-grass. Sphagnous swamps. Ann Arbor, Allmend. Cat.; Flint; Bay Co.; Hubbardston, Vestaburg, C. A. Davis, northward. Infrequent. Th.

421. E. Virginicum album A. Gray. Keweenaw Co., O. A. Farwell.

FUIRENA Rottb.

422. F. squarrosa Michx. Squarrose Fuirena. *F. squarrosa pumila* Torr. Macomb Co., Dr. D. Cooley. Rare. C.

HEMICARPHA Nees and Arn.

*423. **H. micrantha** (Vahl.) Britton. C. & S. *H. subsquarrosa* Nees. S. W., Wright Cat.; Pine Lake, Ingham Co. Rare.

RHYNCHOSPORA Vahl.

424. **R. alba** (L.) Vahl. White Beaked-rush. Bogs. Ann Arbor, Allmend. Cat.; Macomb Co.; Hubbardston; N. E., Winch. Cat.; Keweenaw Co., F.; Mackinaw City, Wheeler; Alma, Ann Arbor, C. A. Davis. Th.

425. **R. capillacea** Torr. Capillary Beaked-rush. Bogs and sandy lake shores. Hubbardston; Flint; Macomb Co.; Petoskey; St. Clair Co.; Jackson Co., C. A. Davis. Infrequent. Th.

426. **R. capillacea laeviseta** Hill. C. K. Dodge. Shore Grand Traverse Bay, near Torch Lake, E. J. Hill; Saginaw and Tuscola Counties, C. A. Davis; Orion, O. A. Farwell.

427. **R. cymosa** Ell. Sturgis, F. P. Daniels.

428. **R. fusca** R. & S. Escanaba, E. J. Hill.

*429. **R. glomerata** (L.) Vahl. Clustered Beaked-rush. S. Mich., Wright Cat. Macomb Co.; Hubbardston; Pine Lake, Ingham Co.; St. Clair Co., C. K. Dodge; Keweenaw Co., O. A. Farwell; Vestaburg, C. A. Davis.

CLADIUM P. Browne.

*430. **C. mariscoides** Torr. Twig-rush. Bogs. S. Mich., Winch. Cat.; Macomb Co.; Flint; Hubbardston; Cheboygan Co., B. & K.; Tuscola and Washtenaw Counties, C. A. Davis. L. P.

SCLERIA Berg.

431. **S. triglomerata** Michx. Tall Nut-rush. S. Mich., Wright Cat., Macomb Co.; Flint; St. Clair Co.; C. K. Dodge; Livingston Co. Rare. S.

432. **S. verticillata** Muhl. Low Nut-rush. S. Macomb Co., D. Cooley; St. Clair Co., C. K. Dodge; Orion, O. A. Farwell; Sebewaing, C. A. Davis. Rare.

CAREX L.

433. **C. abacta** Bailey. Yellowish Sedge. *C. Michauxiana* Boeckl. Keweenaw Co., O. A. Farwell; near Portage River. T. C. Porter.

434. **C. adusta** Boott. Browned Sedge. Crawford Co., Bailey; Grayling, G. H. Hicks. Rare.

*435. **C. alata** Torr. Broad-winged Sedge. *C. straminea alata* Bailey. Keweenaw Co., O. A. Farwell; Crystal Lake, Montcalm Co., Wheeler; South Haven; Niles, Dr. G. L. Ames, in University Herb.

436. **C. albolutescens cumulata** Bailey. Bay Co., G. M. Bradford.

*437. **C. Albursina** Sheldon. White Bear Sedge. *C. laxiflora latifolia* Boott. Fox-tail Sedge. Macomb Co.; Gray's Man.; Agricultural College grounds; Ypsilanti, O. A. Farwell. Frequent. S.

*438. **C. alopecoidea** Tuckerman. Fox-tail Sedge. Macomb Co.; Gray's Man.; Agricultural College grounds; Ypsilanti, O. A. Farwell.

439. **C. alopecoidea sparsispicata** Dewey. Flint, Clark; Macomb Co., Cooley; Detroit, O. A. Farwell.

440. **C. alpina** Swartz. Alpine Sedge. Isle Royale, Whitney Cat. U. P.

441. **C. altocaulis** (Dewey) Britton. Sheathed Sedge. *C. Saltuensis* Bailey. Keweenaw Co., O. A. Farwell; Oscoda Co., L. H. Bailey. N. & U. P.

*442. **C. aquatilis** Wahl. Water Sedge. Margins of streams. S. Mich., Wright Cat.; Flint; Macomb Co., Hubbardston; Sitting Rabbit, Winch. Cat.; Alma, Ann Arbor, C. A. Davis. Infrequent. Th.

443. **C. aquatilis elatior** Bab. Bay Co., G. M. Bradford. Belle Isle, O. A. Farwell.

444. **C. arcta** Boott. Northern Clustered Sedge. *C. canescens polystachya* Boott. Keweenaw Co., O. A. Farwell.

445. **C. arctata** Boott. Drooping Wood Sedge. Woods. S. Mich., Winch. Cat.; Petoskey; Hubbardston; Grand Ledge; Van Buren Co., Bailey. Th.

446. **C. arctata Faxoni** Bailey. Isle Royale, Dr. Sandberg; Keweenaw Co., O. A. Farwell.

447. C. arctata x castanea Bailey. Keweenaw Co., O. A. Farwell.

*448. C. aristata R. Br. Awned Sedge. *C. trichocarpa aristata* Bailey. Agricultural College grounds; northward to Lake Superior.

*449. C. Asa-Grayi Bailey. Gray's Sedge. *C. Grayi* Carey. Low grounds. Macomb Co.; Flint; Hubbardston; Lenawee Co., Detroit, O. A. Farwell. Rare.

*450. C. aurea Nutt. Golden-fruited Sedge. Borders of cool springs. S. E. Wright Cat.; Ann Arbor, Allmend. Cat.; Macomb Co.; Pine Lake, Ingham Co.; Hubbardston; Petoskey and northward; St. Clair Co., C. K. Dodge. Infrequent. Th.

451. C. Bicknellii Britton. Bicknell's Sedge. *C. straminea Crawei* Boott. Ann Arbor, Dr. D. Clark; Grass Lake, C. F. Wheeler.

*452. C. bromoides Schk. Brome-like Sedge. Low grounds. Common. Th.

453. C. brunnescens (Pers.) Poir. Brownish Sedge. *C. canescens alpicola* Wahl. Keweenaw Co., O. A. Farwell.

*454. C. brunnescens gracilior Britton. *C. canescens vulgaris* Bailey. Common.

*455. C. canescens L. Silvery Sedge. In swamps. Th.

456. C. capillaris L. Hair-like Sedge. Point de Tour, Lake Michigan, A. Gray; Sturgeon Point, Alcona Co.; Mackinaw, G. H. Hicks. Common in the Lake Superior region. N. & U. P.

*457. C. Careyana Torr. Cary's Sedge. Rich woods. Macomb Co.; Flint; Hubbardston; southward. Alma, C. A. Davis. Rare. S.

458. C Caroliniana Schwein. Carolina Sedge. Lapeer, Miss M. Owen.

459. C. castanea Wahl. Chestnut Sedge. Keweenaw Co., O. A. Farwell. Th.

*460. C. cephaloidea Dewey. Thin-leaved Sedge. Fields. Macomb Co., Cooley; Ann Arbor, Allmend. Cat.; St. Clair Co., C. K. Dodge; Alma, C. A. Davis; Detroit, O. A. Farwell. Rare. C. & S.

*461. C. cephalophora Muhl. Oval-headed Sedge. Open woods. Common. C. & S.

*462. C. chordorhiza L. f. Creeping Sedge. Th. Upland swamps. Macomb Co.; Hubbardston. Rare. Th.

*463. C. comosa Boott. Bay Co., G. M. Bradford; C. & S.

464. C. conjuncta Boott. Manistee, F. P. Daniels.

465. C conoidea Schk. Field Sedge. S. E. Wright Cat.; Flint; Manistee, F. P. Daniels; Ann Arbor, C. A. Davis. Infrequent. C. & S.

466. C. costellata Britton. Ribbed Sedge. Th. *C. virescens costata* Dew. S. Mich., Winch. Cat.; Detroit; Constantine, Dundee, Wheeler; So. Haven; Keweenaw Co., O. A. Farwell.

467. C. Crawei Dewey. Crawe's Sedge. Macomb Co., Cooley; Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge; Tuscola Co., C. A. Davis; Bay Co., G. M. Bradford. Rare.

468. C Crawfordii Fernald. Keweenaw Co., O. A. Farwell.

*469. C. crinita Lam. Low grounds. Common. Th.

*470. C. cristatella Britton. Crested Sedge. Th. *C. tribuloides cristata* Bailey. Hubbardston, Wheeler. Rare.

*471. C. Crus-Corvi Shuttlew. Raven's-foot Sedge. Valley of River Raisin near Dundee; Reform school marsh, Lansing, C. F. Wheeler. The only localities known in the State.

*472. C. Davisii Schwein & Torr. Davis' Sedge. Keweenaw Co., Farwell. Rare.

*473. C. decomposita Muhl. Large-panicled Sedge. Hubbardston; Ann Arbor, Allmendinger Cat.; S. Mich., Wright Cat.; Lansing, Bailey. Very rare.

474. C. deflexa Hornem. Northern Sedge. Keweenaw Co., O. A. Farwell.

475. C. deflexa Deanei Bailey. Keweenaw Co., O. A. Farwell; Mackinaw, G. H. Hicks.

476. C. deflexa Farwellii Britton. *C. deflexa meadia* Bailey. Keweenaw Co., O. A. Farwell.

*477. C. Deweyana Schwein. Dewey's Sedge. Woods. Frequent. Th.

*478. C. digitalis Willd. Slender Wood Sedge. Macomb Co.; Flint; Hubbardston. Frequent. S.

*479. C. digitalis copulata Bailey. Hubbardston; southward.

480. C. durifolia Bailey. *C. Backii* Boott. Orion, Keweenaw Co., O. A. Farwell; Ontonagon River, Whitney Cat.; West Harrisville, Alcona Co. Rare.

482. C. exilis Dewey. Coast Sedge. Keweenaw Peninsula, O. A. Farwell. The only stations known in the State for this rare species.

*483. C. festucacea Willd. Fescue Sedge. *C. straminea brevior* Dewey. Common. Th.

*484. C. filiformis L. Slender Sedge. Bogs. Alma, Ann Arbor, C. A. Davis; S.

Mich., Wright Cat.; Hubbardston; Macomb Co.; Flint; common at Pine Lake, Ingham Co.; Keweenaw Co., O. A. Farwell; Towar's Swamp, Lansing.

486. **C. flacca** Shreb. *C. glauca* Scop. South shore of Belle Isle, O. A. Farwell.

487. **C. flava** L. Yellow Sedge. Sphagnous swamps. Frequent. Th.

488. **C. flava graminis** Bailey. Crawford Co., Bailey; Keweenaw Co., O. A. Farwell. Rare.

489. **C. foenea** Willd. Hay Sedge. Alger's Camp, Alcona Co.; Potts; Oscoda Co.; Crawford Co.; Isle Royale, Dr. J. H. Sandberg.

490. **C. foenea perplexa** Bailey. Port Huron, C. K. Dodge; Muskegon, Mrs. H. W. Fallars. Northward.

491. **C. folliculata** L. Long Sedge. S. Mich., Wright Cat.; So. Haven; Flint; Macomb Co., to L. Superior. Rare. Th.

*492. **C. formosa** Dewey. Handsome Sedge. Macomb Co.; St. Clair Co., C. K. Dodge; Bay Co., G. M. Bradford. Rare. Th.

*493. **C. fusca** All. Brown Sedge. Bogs. S. E., Winch. Cat.; Macomb Co.; Hubbardston; northward to L. Superior, Whitney Cat.; Alma, C. A. Davis. Irefrequent. Th.

*494. **C. gracillima** Schwein. Graceful Sedge. Wet meadows. Th.

*495. **C. granularis** Muhl. Meadow Sedge. Low grounds. Common. Th.

496. **C. granularis Shriveri** Britton. *C. Haleana* Olney. Frequent in low, clay ground, C. F. Wheeler.

*497. **C. grisea** Wahl. Gray Sedge. Moist woods. Variable. Th.

*498. **C. gynandra** Schwein. Nodding Sedge. *C. crinita gynandra* Schwein. Low grounds. Common. Th.

*499. **C. Hartii** Dewey. Hart-Wright's Sedge. *C. retrorsa Hartii* A. Gray. Hubbardston; Agricultural College Farm; Keweenaw Co., O. A. Farwell. Th.

500. **C. Haydeni** Dewey. Hayden's Sedge. *C. stricta decora* Bailey. Peche Isle and Belle Isle, C. F. Wheeler.

*501. **C. Hitchcockiana** Dewey. Hitchcock's Sedge. Woods. Flint; Hubbardston and southward. S.

502. **C. Houghtonii** Torr. Houghton's Sedge. North part of Clare Co.; Keweenaw Co.; Cheboygan Co.; Oscoda northward. N. & U. P.

*503. **C. hystricina** Muhl. Porcupine Sedge. Wet meadows. Common. Th.

504. **C. hystricina Dudleyi** Bailey. Owosso, G. H. Hicks; Manistee, F. P. Daniels; Bay Co., G. M. Bradford.

*505. **C. interior** Bailey. Keweenaw Co., Orion, Detroit, O. A. Farwell. Common. Th.

*506. **C. intumescens** Rudge. Bladder Sedge. Swamps. South Haven and northward. Common. Th.

507. **C. intumescens Fernaldi** Bailey. Detroit, O. A. Farwell.

*508. **C. Jamesii** Schwein. James' Sedge. Keweenaw Co., O. A. Farwell; Cassopolis; Dundee. Infrequent. Th.

*509. **C. lanuginosa** Michx. Woolly Sedge. *C. filiformis latifolia* Boeckl. Keweenaw Co. and Detroit, O. A. Farwell; Bay Co., G. M. Bradford; Flint; Macomb Co.; Hubbardston; Alma; Ann Arbor, C. A. Davis.

510. **C. laxiculmis** Schwein. Spreading Sedge. Washington, Macomb Co., Dr. Cooley; St. Clair Co., C. K. Dodge. Rare.

*511. **C. laxflora** Lam. Loose-flowered Sedge. Beech and maple woods. Exceedingly variable. Common. Th.

*512. **C. laxiflora blanda** (Dewey) Boott. *C. laxiflora striatula* Carey. Ypsilanti, Detroit, O. A. Farwell; Bay Co., G. M. Bradford.

513. **C. laxiflora patulifolia** (Dewey) Carey. Frequent in center and south.

*515. **C. laxiflora varians** Bailey. Keweenaw Co., O. A. Farwell; southward. Common. Th.

516. **C. lenticularis** Michx. Lenticular Sedge. "Upper Michigan," Gray; Laughing Fish R., L. Superior, Henry Gillman. U. P.

*517. **C. leptalea** Wahl. Bristle-stalked Sedge. *C. polytrichoides* Willd. Low grounds. Common. Th.

*518. **C. limosa** L. Mud Sedge. Bogs. Ann Arbor, Allmend. Cat.; Macomb Co.; Hubbardston and northward. Irefrequent. Th.

519. **C. livida** (Wahl) Willd. U. P. Lake Superior, Gray's Manual; St. Clair Co., C. K. Dodge. Rare.

*520. **C. longirostris** Torr. Long-beaked Sedge. Woods. Flint; Hubbardston and northward; St. Clair Co., C. K. Dodge. Rare.

*521. **C. lupulina** Muhl. Hop Sedge. Low grounds. Common. Th.

522. **C. lupulina x lupuliformis** C. A. Davis. New hybrid. Alma, C. A. Davis.

*523. **C. lupulina pedunculata** Dew. "With the species, but not common," L. H. Bailey in Gray's Manual, 6th ed. Frequent at Lansing.

*524. **C. luplina x retrorsa** Dudley. Lansing, Bailey; Alma, C. A. Davis.

*525. **C lupuliformis** Sartwell. Hop-like Sedge. Washington, Dr. D. Cooley; Lansing, C. F. Wheeler; Alma, C. A. Davis.

526. **C. lurida** Wahl. Sallow Sedge. Antrim Co.; S. Mich., Wright Cat.; So. Haven; Hubbardston; Keweenaw Co., O. A. Farwell. Th.

*527. **C. lurida flaccida** Bailey. Detroit, O. A. Farwell.

*528. **C. lurida subglobosa** Fernald. Near the Agricultural College, C. F. Wheeler.

*529. **C. Magellanica** Lam. Magellan Sedge. Sphagnous swamps. Local. Th.

*530. **C. Meadii** Dewey. Mead's Sedge. *C. tetanica Meadii* Bailey. Sphagnous swamps. Macomb Co.; Hubbardston; Constantine. Infrequent.

*532. **C. monile** Tuckerman. Necklace Sedge. Th. Mud Lake, Petoskey, E. J. Hill; Keweenaw Co., O. A. Farwell; Colon, Wheeler; Reform School marsh, Lansing; Alma, Ann Arbor, C. A. Davis. Th.

533. **C. monile x utriculata,** O. A. Farwell. Sphagnum swamps. Keweenaw Co., O. A. Farwell.

*534. **C. Muhlenbergii** Schk. Muhlenberg's Sedge. Fields. Hubbardston; Bay City; Macomb Co.; southward. Infrequent. C. & S.

*535. **C. Muskingumensis** Schwein. Muskingum Sedge. Hubbardston; Flint; near Owosso, G. H. Hicks; St. Clair Co., C. K. Dodge; Ann Arbor and Alma, C. A. Davis; Ypsilanti, Detroit, O. A. Farwell; Manistee, F. P. Daniels. C. & S.

536. **C. oligocarpa** Schk. Few-fruited Sedge. Flint; Macomb Co., Dr. D. Cooley; Cassopolis, Wheeler; Detroit, Dr. Lyons.

537. **C. oligosperma** Michx. Few-seeded Sedge. Borders of swamps and lakes. Hubbardston; Woodward Lake; Houghton Lake; Crawford Co.; Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis.

538. **C. pallescens** L. Pale Sedge. Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell; Sault de Ste. Marie, Macoun.

*539. **C. pauciflora** Lightfoot. Few-flowered Sedge. U. P., Dr. A. B. Lyons; Chocolate R., L. Superior, Henry Gillman; Towar's swamp near Agricultural College; Alma, Ann Arbor, C. A. Davis.

*540. **C. pedicellata** (Dewey) Britton. Fibrous-rooted Sedge. Th. *C. communis* Bailey.

*541. **C. pedicellata Wheeleri** (Bailey) Britton. *C. communis Wheeleri* L. H. Bailey. Hubbardston; Grand Ledge; Alcona Co.; Mackinac, G. H. Hicks; Keweenaw Co., O. A. Farwell. Infrequent.

*542. **C. pedunculata** Muhl. Long-stalked Sedge. Hillsides. Alma, C. A. Davis; Bay Co., G. M. Bradford. Infrequent. Th.

*543. **C. Pennsylvanica** Lam. Pennsylvania Sedge. Dry woods. Our commonest Sedge. Th.

*544. **C. plantaginea** Lam. Plantain-leaved Sedge. Hillsides. Alma, C. A. Davis. Scarce. Th.

*545. **C. platyphylla** Carey. Broad-leaved Sedge. Grand Rapids, Coleman's Cat.; Hubbardston; St. Clair Co., C. K. Dodge. Infrequent. S.

546. **C. prasina** Wahl. Drooping Sedge. Wet meadows. Hubbardston; S. Mich., Winch. Cat.; Flint; Port Huron, C. K. Dodge; Alma, C. A. Davis. Rare. S.

547. **C praticola** Rydb. *C. pratensis* Drej. not Hose. Northern Meadow Sedge. Pic River, Lake Superior, C. Loring.

548. **C. Pseudo-Cyperus** L. Cyperus-like Sedge. Margins of streams. S. Mich., Wright Cat.; Macomb Co.; Hubbardston; Sturgis, F. N. Daniels; Alma, Ann Arbor, C. A. Davis; northward. Infrequent. Th.

*549. **C. pubescens** Muhl. Pubescent Sedge. S. Mich., Wright Cat.; Macomb Co.; Hubbardston to Lake Superior, Whitney Cat. Frequent. Th.

550. **C. Redowskyana** C. A. Myer. Redowsky's Sedge. *C. gynocrates* Wormskiold. N. E. and N. W., Winch. Cat.; Sturgeon Point, Alcona Co.; Mio, Oscoda Co.; Manistee, F. P. Daniels.

551. **C. retroflexa** Muhl. Reflexed Sedge. *C. rosea retroflexa* Torr. Frequent. S.

*552. **C. retrorsa** Schwein. Retrorse Sedge. River banks. Frequent. Th.

553. **C. Richardsonii** R. Br. Richardson's Sedge. Barrens. Ionia Co.; Macomb Co.; Gaylord, G. E. Hancorne; Orion, O. A. Farwell. Scarce.

555. **C. riparia** W. Curtis. River-bank Sedge. Wet places. Common. Th.

*556. **C. rosea** Schk. Stellate Sedge. Moist woods. Frequent. S.

*557. **C. rosea radiata** Dewey. Dry woods. Frequent. Th.

*558. **C. Sartwellii** Dewey. S. Mich., Winch. Cat.; Macomb Co.; Flint; Hubbardston; Orion, O. A. Farwell; and northward. Th.

*559. **C. scabrata** Schwein. Rough Sedge. Banks of streams. Flint; Grand Rapids, Coleman Cat.; Hubbardston to Lake Superior, Whitney Cat. Infrequent.

560. **C. Schweinitzii** Dew. Schweinitz's Sedge. Near Fraser's, Crawford Co., Prof. L. H. Bailey. Only station known in State.

561. **C. scirpoidea** Michx. Scirpus-like Sedge. Winch. Cat.; Drummond's Isle; Keweenaw Co., O. A. Farwell. N. E.

*562. **C. scoparia** Schk. Pointed Broom Sedge. Th. *C. scoparia minor* Boott. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford. Low grounds. Common.

563. **C. setifolia** (Dewey) Britton. Brittle-leaved Sedgw. Th. *C. Eburnea* Boott. Hillside. South Haven on sand dunes and northward. Infrequent.

*564. **C. siccata** Dewey. Dry-spiked Sedge. Barrens. Macomb Co.; Flint; Hubbardston; near Park Lake, Clinton Co.; northward to Lake Superior. Infrequent.

*565. **C. sparganioides** Muhl. Burr-reed Sedge. Low, rich grounds, St. Clair Co., C. K. Dodge. Infrequent. C. & S.

*566. **C. squarrosa** L. Squarrose Sedge. S. Mich., Wright Cat.; Hubbardston; Lansing, Bailey; Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis. Rare.

567. **C. sterilis** Willd. Little Prickly Sedge. *C. echinata microstachys* Boeckl. S. Mich., Winch. Cat.; Hubbardston; Flint; Macomb Co.; Orion and Keweenaw Co., O. A. Farwell; and northward. Common.

568. **C. sterilis cephalantha** Bailey. *C. echinata cephalantha* Bailey. Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.

*569. **C. stipata** Muhl. Awl-fruited Sedge. Low grounds. Common. Th.

*570. **C. straminea** Willd. Straw Sedge. Ann Arbor, Allmendinger Cat.; Macomb Co.; Flint; Hubbardston; South Haven; northward to Keweenaw Co., O. A. Farwell. Frequent. Th.

571. **C. straminea ferruginea** (A. Gray.) Bailey. Detroit, O. A. Farwell; Port Huron, Algonac, C. K. Dodge; Bay Co., G. M. Bradford.

*572. **C. straminea mirabilis** (Dewey) Tuck. *C. mirabilis* Dewey. Alma, Ann Arbor, C. A. Davis; Hubbardston and northward. Infrequent. Th.

*573. **C. stricta** Lam. Tussock Sedge. Low grounds. Common. Th.

574. **C. stricta angustata** (Boot) Bailey. Less common than the species. Ann Arbor, C. A. Davis; Hubbardston, Wheeler; Keweenaw Co., O. A. Farwell.

575. **C stricta x filiformis** Bailey. Keweenaw Co., O. A. Farwell.

576. **C. sychnocephala** Carey. Dense Long-beaked Sedge. Crystal, Montcalm Co. Only station known in the State, C. F. Wheeler. S.

*577. **C. tenella** Schk. Soft-leaved Sedge. Sphagnous swamps. Common.

*578. **C. tenuiflora** Wahl. Sparse-flowered Sedge. U. P., Whitney Cat.; Oscoda Co.; Towar's swamp, near Lansing, Wheeler, 1890; Keweenaw Co., O. A. Farwell. Th.

579. **C. tenuis** Rudge. Slender-stalked Sedge. *C. debilis Rudgei* Bailey. Bear Lake, Van Buren Co., E. J. Hill; shores of Barron Lake, Cass Co.; Gaylord; Alcona Co.

580. **C. tenuis interjecta** (Bailey) Britton. *C. debilis interjecta* Bailey. Grayling, W. J. B.

*581. **C. teretiuscula** Good. Lesser-paniceled Sedge. Swamps. Common. Th.

*582. **C teretiuscula prairea** (Dewey) Britton. *C. teretiuscula ramosa* Boott. Orion, O. A. Farwell. Frequent.

*583. **C. tetanica** Schkuhr. Woods Sedge. S. Mich., Winch. Cat.; Grand Ledge, C. F. Wheeler; near Pine Lake, Ingham Co., L. H. Bailey; Macomb Co.; Flint, and northward.

*584. **C. tetanica Woodii** Bailey. Central part of the State. Infrequent.

*585. **C. tribuloides** Wahl. Blunt-broom Sedge. Th.

*586. **C. tribuloides Bebbii** Bailey. Bay Co., G. M. Bradford; Detroit, O. A. Farwell. Th.

587. **C. tribuloides moniliformis** (Tuck.) Britton. *C. tribuloides reducta* Bailey. Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels; Alma, C. A. Davis; Bay Co., G. M. Bradford.

588. **C. tribuloides turbata** Bailey. Swales. Keweenaw, O. A. Farwell. Frequent.

589. **C. triceps hirsuta** Bailey. In an oak wood on the farm of Hon. N. B. Hayes, in North Plains township, Ionia Co. Not known to occur elsewhere in the State.

*590. **C. trichocarpa** Muhl. Hairy-fruited Sedge. S. Mich., Wright Cat.; Macomb Co. Infrequent. C. & S.

*591. **C. trisperma** Dewey. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford.

*592. **C. Tuckermani** Dewey. Tuckerman's Sedge. Swamps. S. Mich., Wright Cat.;

Hubbardston; Flint; Macomb Co., and northward; Alma, Ann Arbor, C. A. Davis. Frequent.

*593. **C. umbellata** Schk. Umbel-like Sedge. Grand Ledge, C. F. Wheeler; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels. Rare.

594. **C. umbellata vicina** Dewey. Alcona Co.; Keweenaw Co., O. A. Farwell; Grand Ledge, C. F. Wheeler; St. Clair Co., C. K. Dodge.

*595. **C. utriculata** Boott. Bottle Sedge. Swamps. Common. Th.

576. **C. varia** Muhl. Emmons' Sedge. Barron Lake; New Buffalo; Monroe Co.; dunes of South Haven, L. H. Bailey; Oscoda Co.; Crawford Co.; Grand Traverse, Winch. Cat.; Keweenaw Co., O. A. Farwell.

597. **C. virescens** Muhl. Dewey. Green Sedge. Detroit, O. A. Farwell; Wayne, C. A. Davis.

598. **C. viridula** Michx. Green Sedge. *C. flava viridula* Bailey. Margins of lakes. Frequent. Th.

*599. **C. vulpinoidea** Michx. Fox Sedge. Low meadows. Common. Th.

600. **C. Willdenovii** Schk. Willdenow's Sedge. Bear Lake, Van Buren Co., E. J. Hill. Rare.

ARACEÆ Neck. Arum Family.

ARISAEMA Mart.

*601. **A. Dracontium** (L.) Schott. Green Dragon. Dragon-root. C. & S.

*602. **A. triphyllum** (L.) Torr. Indian Turnip. Rich woods. Th.

PELTANDRA Raf.

*603. **P. Virginica** (L.) Kunth. Green Arrow-arum. *P. undulata* Raf. S. Mich., Wright Cat.; Huron River, Allmendinger Cat.; Ionia Co.; Bay Co., G. M. Bradford; Flint. C. & S.

CALLA L.

*604. **C. palustris** L. Water Arum. Bogs. Frequent. Th.

SPATHYEMA Raf. SYMPLOCARPUS Salisb.

*605. **S. foetida** (L.) Raf. Skunk Cabbage. *Symplocarpus foetidus* Nutt. Th.

ACORUS L.

*606. **A. Calamus** L. Margin of streams. Infrequent. Th.

LEMNACEÆ Dumort. Duckweed Family.

SPIRODELA Schleid.

*607. **S. polyrhiza** (L.) Schleid. Greater Duckweed. Ponds. Common.

LEMNA L. Duckweed. Duck's-meat.

*608. **L. minor** L. Lesser Duckweed. Th. Ponds Blossoms occasionally in June. Common.

609. **L. perpusilla** Torr. Minute Duckweed. Detroit River, D. H. Campbell; Dr. A. B. Lyons. Rare. C. & S.

*610. **L. trisulca** L. Ivy-leaved Duckweed. Ponds. Frequent. C. & S.

WOLFFIA Horkel.

611. **W. Columbiana** Karst. Columbia Wolffia. Abundant on Maple River, Clinton Co.; Ionia Co.; Detroit, J. M. Bigelow.

612. **W. punctata** Griseb. Brazil Wolffia. *W. Brasiliensis* Engelm., not Wedd. Abundant on Maple River, Clinton Co.; Ionia Co.; Detroit, J. M. Bigelow; Bay Co., G. M. Bradford.

XYRIDACEÆ Lindl. Yellow-eyed Grass Family.

XYRIS L.

613. **X. flexuosa** Muhl. Macomb Co.; S. W., Wright Cat.; Hubbardston, Wheeler; Manistee, F. P. Daniels; Vestaburg, C. A. Davis; S. W., H. S. Pepoon. Rare.

614. **X montana** H. Ries. Yellow-eyed Grass. *X. flexuosa pusilla* A. Gray. Lake Superior, Gray's Manual, 6th edition.

ERIOCAULACEÆ Lindl. Pipewort Family.

ERIOCAULON L.

615. **E. septangulare** With. Margin of Long Lake, Cheboygan Co., B. & K.; S. W., Wright Cat.; Macomb Co.; Cooley; Escanaba, E. J. Hill; Alma, C. A. Davis. Infrequent. L. P.

COMMELINACEÆ Reichenb. Spiderwort Family.

COMMELINA L.

616. **C. Virginica** L. Virginia Day-flower. S. W. Wright Cat.

TRADESCANTIA L. Spiderwort.

617. **T. reflexa** Raf. Grass Lake, Cassopolis, Muskegon, C. F. Wheeler; Algonac Co., W. S. Cooper.

618. **T. Virginica** L. Common Spiderwort. Moist wooks. Ionia Co.; Grand Rapids; Ann Arbor, Allmendinger Cat.; Hillsdale Co. Frequent. C. & S.

PONTEDERIACEÆ Dumort. Pickerel-weed Family.

PONTEDERIA L.

*619. **P. cordata** L. Pickerel-weed. Borders of lakes and slow streams. Lakes in Oakland Co.; Ann Arbor; Ionia Co., and northward. Th.

*620. **P. cordata lancifolia** (Muhl.) Morong. *P. cordata angustifolia* Torr. Lake St. Clair; Pine Lake, Ingham Co.

HETERANTHERA R. & P.

*621. **H. dubia** (Jacq.) MacM. Water Star-grass. *H. graminea* Vahl. Ann Arbor, Allmend. Cat.; Dexter, Dr. Elmore Palmer; Grand Rapids; Bay Co.; Hubbardston; Alma, C. A. Davis. In streams. Common. C. & S.

JUNCACEÆ Vent. Rush Family.

JUNCUS L.

*622. **J. acuminatus** Michx. Short-fruited Rush. Macomb Co.; Fruitport, E. J. Hill; Hubbardston; Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge; Alma, C. A. Davis.

623. **J. articulatus** L. Pointed Rush. Alger, C. F. Wheeler; Tuscola County, C. A. Davis. Th.

624. **J. Balticus littoralis** Engelm. Sandy shores. S. Haven, Bailey; to Petoskey; Port Huron; Bay Co., G. M. Bradford. Oscodo and northward. A form of this species is found at Hubbardston, Ionia Co., Wheeler; Port Austin, C. A. Davis. Th.

625. **J. brachycarpus** Engelm. Short-fruited Rush. St. Clair Co., C. K. Dodge.

*626. **J. brachycephalus** (Engelm.) Buch. Small-headed Rush. *J. Canadensis brachycephalus* Engelm. Hubbardston; Howell Junction, C. F. Wheeler; Bay Co., G. M. Bradford. S.

*627. **J. bufonius** L. Toad Rush. Roadsides. Common. Th.

*628. **J. Canadensis** J. Gay. Canada Rush. Fruitport, E. J. Hill; Macomb Co.; Hubbardston; northward to Sault Ste. Marie, Burgess; Alma, C .A. Davis. Common. Th.

629. **J. Canadensis brevicaudatus** Engelm. *J. Canadensis coarctatus* Engelm. Detroit; north shore of Lake Superior, Dr. Lyons; Keweenaw Co., O. A. Farwell.

*631. **J. conglomeratus** L. Glomerate Rush. *J. effusus conglomeratus* Engelm. Swamps; not so common as the species.

632. **J. Dudleyi** Wieg. Keweenaw Co., Detroit, O. A. Farwell.

*633. **J. effusus** L. Common or Soft Rush. Marshy grounds. Common. Th.

634. **J. filiformis** L. Thread Rush. Adrian, Tuthill; Saginaw Bay, Winch. Cat.; L. Superior, Jno. Macoun. Rare.

635. **J. Gerardi** Loisel. Black-grass. "Rare about the Great Lakes," Gray's Manual.

636. **J. Greenii** Oakes & Tuck. Green's Rush. Head of Lake Michigan, Gray's Manual, 6th edition; Detroit, Wheeler; Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge. Rare.

637. **J. interior** Wieg. *J. tenuis secundus* Engelm. Palmer Park, Detroit, C. F. Wheeler; Twin Lake, Muskegon Co., C. F. Wheeler.

638. **J. marginatus** Rostk. Grass-leaved Rush. S. Mich., Winch. Cat.; Macomb Co., Dr. D. Cooley; Grand Rapids, Wheeler; Livingston Co., C. A. Davis. Rare. S.

*639. **J. nodosus** L. Knotted Rush. Gravelly banks. Common. An intermediate form grows with the species on the shore of Litle Traverse Bay, Wheeler.

*640. **J. pelocarpus** E. Meyer. Brownish-fruited Rush. Th. Shore of Woodward Lake, Ionia Co.; Pine Lake, Ingham Co.; Lake Superior; J. Macoun, Can. Cat.; Bear Lake, Manistee Co., E. J. Hill; Macomb Co., Dr. D. Cooley; Vestaburg, C. A. Davis. Infrequent.

*641. **J. Richardsonianus** Schult. Richardson's Rush. *J. alpinus insignis* Fries. "Along the Great Lakes northward and westward." Gray. Common. Along railroad track on Agricultural College Farm. This species has been mistaken by early collectors for J. articulatus, which is confined to the New England States. Engelmann. Th.

642. **J. scirpoides** Lam. Scirpus-like Rush. Sturgis, F. P. Daniels.

644. **J. stygius** L. Moor Rush. "N. shore of Lake Superior, Mr. Wheeler," Gray's Manual, 5th edition; Marquette, E. J. Hill.

*645. **J. tenuis** Willd. Slender Rush. Roadside. Common. Th.

646. **J. Torreyi** Coville. Torrey's Rush. *J. nodosus megacephalus* Torr. Flint; Hubbardston and southward; St. Clair Co., C. K. Dodge; Bay Co., G. M. Bradford.

647. **J. Vaseyi** Engelm. Vasey's Rush. Detroit, Lyons; Lake Superior, John Macoun.

JUNCOIDES Adans. Luzula DC.

*648. **J campestre** (L.) Kuntze. Common Wood-rush. *Luzula campestris* DC.

*649. **J. pilosum** (L.) Kuntze. Hairy Wood-rush. Bay Co., G. M. Bradford. Common. Th.

650. **J. spicatum** (L.) Kuntze. Spiked Wood-rush. *Luzula spicata* DC. Dr. A. B. Lyons. U. P. Woods. Common. Th.

MELANTHACEÆ R. Br. Bunch-flower Family.

TOFIELDIA Hudson.

*651. **T. glutinosa** (Michx.) Pursh. Glutinous Tofieldia. Sphagnous swamps. Frequent. Th.

652. **T. palustris** Hudson. Scottish Asphodel. Isle Royale, Dr. A. B. Lyons. U. P.

CHAMAELIRIUM Willd.

653. **C. luteum** (L.) A. Gray. Blazing Star. *C. Carolinianum* Willd. Dr. A. B. Lyons. U. P.

ZYGADENUS Michx.

*654. **Z. elegans** Pursh. Th. S. W., Wright Cat.; Dexter, Dr. Elmore Palmer; Ann Arbor, Allmend. Cat.; Grand Ledge; Clarkston, G. H. Hicks; Ionia; Davisburg; Petoskey; Ann Arbor, C. A. Davis; Detroit, O. A. Farwell. Rare.

UVULARIA L.

*655. **U. grandiflora** J. E. Smith. Large-flowered Bellwort. Rich woods. Common. C. & S.

656. **U. perfoliata** L. Perfoliata Bellwort. Rich woods. Marquette Co., Burt MS. Cat.; Flint; Macomb Co. Infrequent.

657. **U. sessilifolia** L. Sessile-leave Bellwort. *Oakesia sessilifolia* S. Wats. Low woods. Monroe Co., Wheeler; Ann Arbor, Allmend. Cat.; Ypsilanti; Flint; Macomb Co.; Crystal Lake, Montcalm Co., E. F. Smith, and northward to Marquette Co., Whitney Cat. Th.

LILIACEÆ Adans. Lily Family.

HEMEROCALLIS L.

*658. **H. fulva** L. Common Day-lily. Escaped from cultivation.

ALLIUM L.

*659. **A. Canadense** Kalm. Wild Garlic. Woods. Common. C. & S.

660. **A. cernuum** Roth. Wild Onion. Ann Arbor, Allmend. Cat. S.

661. **A. Sibiricum** L. *A. Schoenoprasum* Ill. Fl., not L. Chives. Dr. A. B. Lyons; Gray's Manual; N. shore of Lake Superior, Agassiz; Keweenaw Point, O. A .Farwell. U. P.

*662. **A. tricoccum** Ait. Wild Leek. Rich woods. Th.

*663. **A. vineale** L. Field Garlic. In the aboretum of the Agricultural College.

LILIUM L.

664. **L. Canadense** L. Wild Yellow Lily. Meadows and along streams. Northward, frequent.

*665. **L. Philadelphicum** L. Wild Orange-red Lily. Ann Arbor, Allmend. Cat.; Hubbardston; Petoskey; and northward. Not common in the central part of the State. There is some doubt about the presence of this plant in Mich.

*666. **L. superbum** L. Turk's-cap Lily. Low grounds. Ann Arbor (Miss Clark), Winch. Cat.; Flint; S. Haven, Bailey; Alma, C. A. Davis. Frequent. C. & S.

667. **L. umbellatum** Pursh. Western Red Lily. Alpena, Traverse City, C. F. Wheeler; St. Clair Co., C. K. Dodge; Bay Co., G. M. Bradford; Keweenaw Co., O. A. Farwell; Birmingham, S. Alexander.

ERYTHRONIUM L.

*668. **E. albidum** Nutt. White Adder's-tongue Violet. Th. Ann Arbor, Allmend. Cat.; Macomb Co.; Flint; Hubbardston. "At L. Superior Dr. Robbins found a plant like this but yellow flowered, a transition toward E. grandiflorum," Gray's Man.; Keweenaw Co., O. A. Farwell.

670. **E. Americanum** Ker. Yellow Adder's-tongue. Low copses. Common. Th.

QUAMASIA Raf. CAMASSIA Lindl.

670. **Q. hyacinthina** (Raf.) Britton. Wild Hyacinth. *Camassia Fraseri* Torr. Adrian, Mrs. I. H. Wheeler; White Island in the Detroit river opposite Amherstburg, Dr. J. Macoun.

MUSCARI Mill.

MUSCARIA.

670a. **M. botryoides** (L.) Mill. *Grape Hyacinth.* Moist grass lands. Ann Arbor, C. A. Davis.

ALETRIS L.

671. **A. farinosa** L. Colic-root Star-grass. Addison, G. F. Comstock; Howard City; Grand Rapids; Ann Arbor, Allmend. Cat.; Macomb Co.; Flint; Clarkston, G. H. Hicks; Hubbardston; Manistee, F. P. Daniels; Ann Arbor, C. A. Davis. Rare. C. & S.

CONVALLARIACEÆ Link. Lily-of-the-Valley Family.

ASPARAGUS L.

*672. **A. officinalis** L. Garden Asparagus. Sparingly escaped from gardens in older parts of the State.

CLINTONIA Raf.

673. **C. borealis** (Ait.) Raf. Yellow Clintonia. Follows the Lake Michigan shore down as far as S. Haven; on the eastern side of the State reaches to Macomb Co., Dr. D. Cooley; and in the center of the State is found in Ionia Co.; Alma, C. A. Davis. Very common north of latitude 43°.

VAGNERA Adans. SMILACINA Desf.

*674. **V. racemosa** (L.) Morong. Wild Spikenard. *Smilacina racemosa* Desf. Moist grounds. Common. Th.

*675. **V. stellata** (L.) Morong. Star-flowered Solomon's Seal. *Smilacina stellata* Desf. Moist banks. Common. Th.

*676. **V. trifolia** (L.) Morong. Three-leaved Solomon's Seal. *Smilacina trifolia* Desf. Sphagnous swamps. Frequent. Th.

UNIFOLIUM Adans. MAIANTHEMUM Wigg.

*677. **U. Canadense** (Desf.) Greene. False Lily-of-the-valley. *Maianthemum Canadense* Desf. Woods, everywhere.

STREPTOPUS Michx.

678. **S. amplexifolius** (L.) DC. Twisted Stalk. Fort Gratiot, Winch. Cat.; Houghton Lake to Lake Superior, where it is rare, Whitney Cat.

679. **S. roseus** Michx. Sessile-leaved Twisted-stalk. Cedar swamps. Mt. Pleasant, Alma, Chas. A. Davis; Cheboygan Co., B. & K.; Bay Co., G. M. Bradford; Drummond's Is., and Sugar Is., Winch. Cat.; to L. Superior where it is very common, Whitney Cat.

SALOMONIA Heist. POLYGONATUM Adans.

*680. **S. biflora** (Walt.) Britt. Smaller Solomon's Seal. *P. biflorum* Ell. Ann Arbor, Winch. Cat.; Ionia Co., and northward. Open woods. Common. Th.

*681. **S. commutata** (R. & S.) Britt. Smooth Solomon's Seal. Th. *P. giganteum* Dietrich. Great S. S. River banks. Stems often very tall and channeled on one side. Intermediate forms between this and the preceding occur. Ann Arbor, C. A. Davis.

MEDEOLA L.

*682. **M. Virginiana** L. Indian Cucumber-root. L. P. Abundant at Gaylord, where it probably reaches its N. limits, G. L. Stewart; Alma and Wayne, C. A. Davis; S. W., H. S. Pepoon.

TRILLIUM L. Wake Robin. Birthroot.

*683. **T. cernuum** L. Nodding Wake-robin. S. Mich., Winch. Cat.; Macomb Co.; Flint; Grand Rapids, Coleman Cat.; northward to Keweenaw, O. A. Farwell; Alma and Ann Arbor, C. A. Davis. Infrequent.

*684. **T. erectum** L. Ill-scented Wake-robin. Ann Arbor, Winch. Cat.; Constantine; Port Huron, Dodge. The white form with declinate pedicels is most common throughout, and the only form in the northern part of the State. Th.

*685. **T. grandiflorum** (Michx.) Salisb. Large-flowered Wake-robin. Rich woods. Exceedingly variable and apt to sport. Common. Th.

686. **T. nivale** Riddell. Dwarf White Trillium. Low woods. One of our earliest spring flowers. Hubbardston; Ionia; Grand Rapids, Coleman Cat., Niles, I. N. Mitchell. Rare. C. & S.

687. **T. recurvatum** Beck. Prairie Wake-robin. Niles, I. N. Mitchell. S. W.

688. **T. sessile** L. Sessile-flowered Wake-robin. Dr. A. B. Lyons; St. Joseph, Wheeler; Niles, I. N. Mitchell. Rare. S.

689. **T. undulatum** Willd. Painted T. *T. erythrocarpum* Michx. S. Mich., Wright Cat.; not observed in the center of the State; Port Huron, Dodge; Keweenaw Co., O. A. Farwell. Infrequent. Th.

SMILACEÆ Vent. Smilax Family.

SMILAX L.

*690. **S. ecirrhata** (Engelm.) S. Wats. Upright Smilax. St. Clair, C. K. Dodge; Belle Isle, O. A. Farwell; Sturgis, F. P. Daniels; Alma, Ann Arbor, C. A. Davis.

*691. **S. herbacea** L. Carrion-flower. River banks. Flowers much visited by blow-flies. Common. Th.

*692. **S. herbacea pulverulenta** (A. Gray.) Michx. Ann Arbor, Allmend. Cat.; Owosso, G. H. Hicks; Alma, C. A. Davis.

*693. **S. hispida** Muhl. Hispid Greenbrier. The common woody species in Ionia and adjacent counties. Ann Arbor, Winch. Cat.; Hubbardston; Flint; Houghton Lake; Alma, Ann Arbor, C. A. Davis; northward to Lake Superior, Whitney Cat.

694. **S. rotundifolia** L. Common Greenbrier. Horse-brier. Ann Arbor, Allmend. Cat.; Flint; Macomb Co.; Kent Co., Coleman Cat.; Benton Harbor. Infrequent. C. & S.

AMARYLLIDACEÆ Lindl. Amaryllis Family.

HYPOXIS L. Star-grass.

695. **H. hirsuta** (L.) Coville. Star-grass. Tuscola county, Ann Arbor, C. A. Davis. *H. erecta* L. Meadows. Common.

DIOSCOREACEÆ Lindl. Yam Family.

DIOSCOREA L.

*696. **D. villosa** L. Wild Yam-root. Rich woods. Frequent. C. & S.

IRIDACEÆ Lindl. Iris Family.

IRIS L.

697. **I. lacustris** Nutt. Dwarf Lake Iris. Bois Blanc I. and Drummond's I., Winch. Cat.; Mackinac, Whitney Cat.; "Shores of L. Huron and Mich.," A. Gray, Lewis Foote; Mackinaw City, Wheeler; Alpena, C. A. Davis.

*698. **I. versicolor** L. Larger Blue Flag. Low grounds. Common. Th.

SISYRINCHIUM L.

*699. **S. albidum** Raf. White Blue-eyed Grass. Barron Lake, C. F. Wheeler; Belle Isle, O. A. Farwell; Kalamazoo, R. M. Gibbs.

*700. **S. angustifolia** Miller. Northern Blue-eyed Grass. Moist grassy places. Common. Th.

701. **S. apiculatum** Bicknell. Muskegon Co., C. D. McLouth.

702. **S. Farwellii** Bicknell. Near Birmingham, Oakland Co., O. A. Farwell.

*703. **S. graminoides** Bicknell. Belle Isle and elsewhere, O. A. Farwell; *S. anceps* S. Wats. Palo, Petoskey, C. F. Wheeler.

704. **S. hastile** Bicknell. Belle Isle, O. A. Farwell.

705. **S. mucronatum** Michx. Michaux's Blue-eyed Grass. Southeast Michigan, O. A. Farwell.

706. **S. strictum** Bicknell. Montcalm Co., Britton's Manual.

ORCHIDACEÆ Lindl. Orchis Family.

CYPRIPEDIUM L.

*707. **C. acaule** Ait. Stemless Ladies' Slipper. Dry woods and sphagnous swamps. Frequent. Th.

708. **C. arietinum** R. Brown. Ram's-head Ladies' Slipper. Isle Royale, Dr. A. B. Lyons; tamarack swamp one-half mile east of Whitmore Lake, W. H. Lewis; Mt. Pleasant, C. A. Davis. Rare.

709. **C. candidum** Willd. Small White Ladies' Slipper. Tamarack swamps. Ann Arbor, Winch. Cat.; Kalamazoo; Macomb Co.; Flint; Hubbardston; Howell Junction, C. F. Wheeler; Keweenaw Co., O. A. Farwell. Rare.

*710. **C. hirsutum** Mill. Large Yellow Ladies' Slipper. *C. pubescens* Willd. Woods, in moist or dry ground. Frequent.

*711. **C. parviflorum** Salib. Smaller Yellow Ladies' Slipper. Very wet swamps. Frequent. Th.

*712. **C. reginae** Walt. Showy Ladies' Slipper. *C. spectabile* Salisb. Swamps. Ann Arbor, Winch. Cat.; Kalamazoo, Tuthill; Macomb Co.; Flint; Hubbardston; Keweenaw Co.; Alma, C. A. Davis. Frequent. Th.

ORCHIS L.

713. **O. rotundifolia** Pursh. Small Round-leaved Orchis. Frankfort, E. J. Parker; Marquette, T. H. Danger; Lake Fumeé, E. J. Hill.

GALEORCHIS Rydb. ORCHIS L., in part.

*714. **G. spectabilis** (L.) Rydb. Showy Orchis. *Orchis spectabilis* L. Rich woods. Scarce. C. & S.

PERULARIA Lindl. HABENARIA Willd., in part.

715. **P. flava** (L.) O. A. Farwell. Tubercled Orchis. *Habenaria flava* (L.) A. Gray. Macomb Co.; Ann Arbor, Winch. Cat.; S. W. Wright Cat.; Cheboygan Co., B. & K.; Bay Co., G. M. Bradford; Alma, C. A. Davis. Infrequent. Th.

COELOGLOSSUM Hartman. HABENARIA Willd., in part.

*716. **C. bracteatum** (Willd.) Parl. Long-bracted Orchis. *Habenaria bracteata* (Willd.) R. Br. Ann Arbor and Emmet Co., Winch. Cat.; Macomb Co.; Kalamazoo; Hubbardston; Flint; Alma, and northward. Th.

GYMNANDENIOPSIS Rydb. HABENARIA Willd., in part.

717. **G. clavellata** (Michx.) Rydb. Small Green Wood Orchis. *Habenaria clavellata* (Michx.) Spreng. Lenawee Co., G. F. Comstock; S. W., Wright Cat.; Ann Arbor, Allmend. Cat.; Hubbardston, Grayling, G. H. Hicks; Alma, C. A. Davis; and northward.

LIMNORCHIS Rydb. HABENARIA Willd., in part.

*718. **L. dilatata** (Pursh.) Rydb. Tall White Bog Orchis. *Habenaria dilatata* (Pursh.) Hook. S. E. Winch. Cat.; Constantine and northward. Th.

719. **L. hyperborea** (L.) Rydb. Tall Leafy Green Orchis. *Habenaria hyperborea* (L.) R. Br. Wet woods. Frequent northward. Th.

LYSIAS Salisb. HABENARIA Willd., in part.

*720. **L. Hookeriana** (A. Gray) Rydb. Hooker's Orchis. *Habenaria Hookeriana* A. Gray. S. E. Winch. Cat.; Hubbardston; Flint; Lake Superior, Whitney Cat.; Alma, C. A. Davis. Rare southward. Th.

*721. **L. orbiculata** (Pursh.) Rydb. Large Round-leaved Orchis. *Habenaria orbiculata* (Pursh.) Torr. Frequent in the pine region, not rare on U. P., Whitney, Cat.; Hubbardston; Alma; Flint. Th.

LYSIELLA Rydb. HABENARIA Willd., in part.

722. **L. obtusata** (Pursh.) Rydb. Small Northern Bog Orchis. *Habenaria obtusata* (Pursh.) Richards. Cheboygan Co., B. & K.; Pictured Rocks, G. H. Hicks; Isle Royale, Dr. A. B. Lyons; L. Superior, common, Whitney Cat.; Cove I.; L. Huron, Austin. N. & U. P.

BLEPHARIGLOTTIS Raf. HABENARIA Willd., in part.

723. **B. blephariglottis** (Willd.) O. A. Farwell. White-fringed Orchis. *Habenaria blephariglottis* (Willd.) Torr. S. Mich., Winch. Cat.; Stanton. Rare. C. & S.

*724. **B. ciliaris** (L.) Rydb. Yellow-fringed Orchis. *Habenaria ciliaris* (L.) R. Br. Ann Arbor, Winch. Cat.; Macomb Co.; Kalamazoo, Tuthill; Niles, I. N. Mitchell; Algonac, W. S. Cooper; Ann Arbor, C. A. Davis. Rare.

725. **B. ciliaris x blephariglottis.** Bay Co., G. M. Bradford.

*726. **B. lacera** (Michx.) Rydb. Ragged Orchis. *Habenaria lacera* (Michx.) R. Br. Ann Arbor, Winch. Cat.; Woodward Lake; Flint; Macomb Co.; Manistee, F. P. Daniels; north to Keweenaw Co., O. A. Farwell. Infrequent. Th.

*727. **B. leucophaea** (Nutt.) O. A. Farwell. Prairie White-fringed Orchis. *Habenaria leucophaea* (Nutt.) A. Gray. Belle Isle, Foerste; Ann Arbor, Winch. Cat.; Pine Lake, Ingham Co.; Woodward Lake, Ionia Co.; Macomb Co.; Alma, C. A. Davis; Isle Royale, Foote; St. Clair Co., C. K. Dodge. Rare.

*728. **B. psycodes** (L.) Rydb. Smaller Purple-fringed Orchis. *Habenaria psycodes* (L.) A. Gray. Low grounds. Frequent. Th.

POGONIA Juss.

*729. **P. ophioglossoides** (L.) Ker. Snake-mouth. Bogs. Common. Th.

ISOTRIA Raf. POGONIA Juss., in part.

730. **I. verticillata** (Willd.) Raf. *Pogonia verticillata* (Willd.) Nutt. Alma, C. A. Davis; Kalamazoo; Flint; Macomb Co. Rare.

TRIPHORA Nutt. POGONIA Juss., in part.

731. **T. trianthophora** (Sw.) Rydb. Nodding Pogonia. *pogonia pendula* Lindl. Dr. Wright; Calvin, Cass Co., I. N. Mitchell; Alma, C. A. Davis. Rare. S. W.

ARETHUSA Gronov.

*732. **A. bulbosa** L. Arethusa. In sphagnous swamps. S. Mich., Wright Cat.; Ann Arbor, Allmend. Cat.; Kalamazoo, Tuthill; Alma, C. A. Davis; Hubbardston, and northward. Rare. Th.

LIMODORUM L. CALOPOGON R. Br.

*733. **L. tuberosum** L. Grass-pink Colopogon. *Calopogon pulchellus* R. Br. Bogs. Alma, Ann Arbor, C. A. Davis. Common. Th.

GYROSTACHYS Pers. SPIRANTHES L. C. Richard.

*734. **G. cernua** (L.) Kuntze. Nodding Ladies' Tresses. *Spiranthes cernua* Richard. Sphagnous swamps. Frequent. Th.

735. **G. gracilis** (Bigel.) Kuntze. Slender Ladies' Tresses. *Spiranthes gracilis* Bigelow. S. W., Wright's Cat.; Macomb Co.; Grand Rapids, Coleman Cat.; Kalamazoo, Tuthill; Long Lake and Pine Plains, Cheboygan Co., B. & K. L. P.

736. **G. plantaginea** (Raf.) Britt. Wide-leaved Ladies' Tresses. *Spiranthes latifolia* Torr. Drummond's Island, common, and S. E., Winch. Cat.; Hubbardston; Flint; Roscommon. Rare in L. P.

737. **G. stricta** Rydb. Hooded Ladies' Tresses. Not *G. Romanzoffiana* as has been supposed. *Spiranthes Romanzoffiana* Chamisso. Borders of Mud Lake, Northport, E. J. Hill; St. Clair Co., A. F. Foerste; Grayling, G. H. Hicks; Tuscola Co., C. A. Davis; Caribou Islet, Porter; northward to L. Superior. Infrequent southward. Th.

LISTERA R. Br.

738. **L. convallarioides** (Sw.) Torr. Round-lipped Twayblade. Not common. Whitney Cat.; Isle Royale, Dr. A. B. Lyons; abundant at Pictured Rocks, G. H. Hicks; Grand

Traverse Co.; Cheboygan Co., B & K.; Keweenaw Co., O. A. Farwell. N. & U. P.

739. **L. cordata** (L.) R. Br. Twayblade. Whitney Cat.; Isle Royale, Dr. A. B. Lyons; Grayling, G. H. Hicks; Keweenaw Co., O. A. Farwell; cedar swamps, Cheboygan Co., B. & K. N. & U. P.

PERAMIUM Salisb. GOODYERA R. Br.

740. **P. Menziesii** (Lindl.) Morong. Menzies' Rattlesnake Plantain. *Goodyera Menziesii* Lindl. Grayling, G. H. Hicks; Boyne Falls, Northport and Frankfort, E. J. Hill; Petoskey; Isle Royale and Traverse Bay, Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell. Rare in Cheboygan Co., B. & K.

*741. **P. pubescens** (Willd.) MacM. Downy Rattlesnake Plantain. *Goodyera pubescens* R. Br. Woods. Frequent. Th.

742. **P. repens ophioides** (Fernald) Heller. Lesser Rattlesnake Plantain. *Goodyera repens* R. Br. Bangor, Van Buren Co., Bailey; Grand Rapids, Coleman Cat.; Roscommon Co., Dr. D. Cooley; Alma, C. A. Davis; Petoskey and northward. Infrequent. Th.

ACHROANTHES Raf. MICROSTYLIS Nutt.

743. **A. monophylla** (L.) Greene. White Adder's-mouth. *Microstylis monophylla* Lindl. Hubbardston; Flint; Macomb Co.; bogs near Long Lake and Black Lake, Cheboygan Co., B. & K. Rare.

744. **A. unifolia** (Michx.) Raf. Green Adder's-mouth. *Microstylis ophioglossoides* Nutt. Ann Arbor, Allmendinger Cat.; Hubbardston; Bay Co., G. M. Bradford; Lenawee Co., F. G. Comstock. Rare.

LEPTORCHIS Thouars. LIPARIS L. C. Richard.

745. **L. liliifolia** (L.) Kuntze. Large Twayblade. *Liparis liliifolia* Richard. S. W. Wright's Cat.

746. **L. Loeselii** (L.) MacM. Fen Orchis. *Liparis Loeselii* Richard. Ann Arbor. Allmendinger Cat.; abundant in a tamarack swamp near Hubbardston; S. Haven, L. H. Bailey; Flint; Macomb Co.; Keweenaw Co., O. A. Farwell; Sault de Ste. Marie, Porter; Alma, C. A. Davis. Th.

CALYPSO Salisb.

747. **C. borealis** (L.) Oakes. Calypso. Forty-mile Point, Presque Isle Co., Winch. Cat.; shores of Higgins Lake, Dr. D. Cooley; Mount Pleasant, E. F. Smith; Grayling, G. H. Hicks; Frankfort, E. J. Parker; Keweenaw Co., O. A. Farwell; Mackinac, Whitney Cat.; L. Superior, J. Macoun. in Can. Cat.

TIPULARIA Nutt.

748. **T. unifolia** (Muhl.) B. S. P. Crane-fly Orchis. *T. discolor* Nutt. Coleman Cat.; N. Mich., D. Cooley; eastern coast of L. Huron, J. Macoun. Our rarest orchid.

APLECTRUM Nutt.

*749. **A. spicatum** (Wallt.) B. S. P. Adam-and-Eve. Putty-root. *A. hiemale* Nutt. Rich woods. Ann Arbor, Allmend. Cat.; Detroit, Gillman; Macomb Co.; Montcalm Co.; Flint; Hubbardston; Grand Rapids, Coleman's Cat.; Niles, Mitchell; Keweenaw Co., O. A. Farwell; Alma, C. A. Davis. Scarce.

CORALLORHIZA R. Br.

*750. **C. Corallorhiza** (L.) Karst. Early Coral-root. *C. innata* R. Br. S. E., Wright Cat.; Park Lake, Clinton Co.; Harmon; Grayling; Frankfort; L. Superior; S. W., H. S. Pepoon. Not rare. Whitney Cat. Th.

*751. **C. multiflora** Nutt. Large Coral-root. Hubbardston; S. W., Wright Cat.; Cheboygan Co., B. & K.; Detroit, O. A. Farwell; Alma, C. A. Davis; northward to Lake Superior. Th.

752. **C. odontorhiza** (Willd.) Nutt. Small-flowered Coral-root. Hubbardston; Flint; Frankfort; Oscoda; northward to Lake Superior, Whitney Cat. Th.

753. **C. striata** Lindl. Striped Coral-root. Frankfort; Comins, Oscoda Co.; abundant at Mackinac; St. Clair Co., C. K. Dodge; Keweenaw Co., O. A. Farwell. Becoming scarce, N. & U. P.

SAURURACEÆ Lindl. Lizard's-tail Family.

SAURURUS L.

*752. **S. cernuus** L. Lizard's-tail. Swamps, river-sides. Common. C. & S.

JUGLANDACEÆ Lindl. Walnut Family.

JUGLANS L.

*753. **J. cinerea** L. Butternut. Low rich woods.
*754. **J. nigra** L. Black Walnut. Becoming scarce from Bay City south. C. & S.

HICORIA Raf. CARYA Nutt.

*755. **H. alba** (L.) Britton. Mocker-nut. *Carya tomentosa* Nutt. Dry Woods. Flint; Grand Rapids, Coleman's Cat.; Three Rivers; Cassopolis, C. F. Wheeler; Ann Arbor, C. A. Davis. Rare. C. & S.
756. **H. borealis** Ashe. Northern Hickory. Belle Isle, Detroit, O. A. Farwell; Rochester, W. A. Brotherton, and probably elsewhere.
757. **H. glabra** (Mill.) Britton. Pig-nut Hickory. *Carya porcina* Nutt. Woods. Alma, Ann Arbor, C. A. Davis. C. & S.
758. **H. laciniosa** (Michx. f.) Sarg. King-nut. *Carya sulcata* Nutt. Monroe Co., White Pigeon, W. J. B.; Teconsha, G. W. Davis; Ann Arbor, C. A. Davis. River bottoms. Rare, except in the extreme south.
759. **H. microcarpa** (Nutt.) Britton. Small-fruited Hickory. *Carya microcarpa* Nutt. Ann Arbor; Cassopolis; Three Rivers. S.
*760. **H. minima** (Marsh.) Britton. Bitter-nut. *Carya amara* Nutt. Common. C. & S.
*761. **H. ovata** (Mill.) Britton. Shag-bark. C. & S. *Carya alba* Nutt. Common. C. & S.
762. **H. villosa** (Sargent) Ashe. Belle Isle, O. A. Farwell.

MYRICACEÆ Dumort. Sweet-Gale Family.

MYRICA L.

763. **M. cerifera** L. Bayberry. Wax-myrtle. S. Mich., Winch. Cat.; Wayne Co., C. A. Davis.
764. **M. Gale** L. Sweet Gale. Swamp near Crooked Lake, Emmet Co.; Harrisville; Manistee, E. J. Hill; Isle Royale, Dr. A. B. Lyons; Roscommon, C. A. Davis. N. & U. P.

COMPTONIA Banks.

764. **C. peregrina** (L.) Coulter. Sweet-fern. *Myrica asplenifolia* L. South, Wr. Cat.; Detroit, Dr. A. B. Lyons; Alma, C. A. Davis. Very common in the center of the State and northward throughout the pine country, of which it is a chracteristic species.

SALICACEÆ Lindl. Willow Family.

POPULUS L.

*765. **P. alba** L. White Poplar. Abele. Occasionally escaped from cultivation.
*766. **P. balsamifera** L. Balsam Poplar. River banks. A small tree in Michigan. Northward. Th.
766a. **P. candicans** Ait. Balm of Gilead. *P. balsamifera candicans* A. Gray. Cultivated, occasional. Indigenous northward.
*768. **P. deltoides** Marsh. Cottonwood. *P. monilifera* Ait. Sometimes a large tree, three feet in diameter. Infrequent. Collected by the Forestry Commission, June, 1888, in Alcona Co. L. P.
*769. **P. dilatata** Ait. Lombardy Poplar. Occasionally escaped from cultivation.
*770. **P. grandidentata** Michx. Large-toothed Aspen. Woods. Common northward, but "rare in U. P." Whitney Cat.; Alma, Ann Arbor, C. A. Davis.

771. P. heterophylla L. Swamp or Downy Poplar. Cass Co., J. H. Roy.
*772. P. tremuloides Michx. American Aspen. Woods and lake shores; most abundant in U. P., Whitney. Common. Th.

SALIX L.

773. S. adenophylla Hook. Tomentose Willow. Beach sand, Lake Michigan, and northward. Petoskey; St. Jo., Dr. Wright in Torr. Herb., Bebb. Hooker's original specimens came from Labrador.
*774. S. alba vitellina (L.) Koch. Golden Willow. Naturalized from Europe.
*755. S. amygdaloides Anders. Peach-leaved Willow. Flint, Dr. D. Clark; Hubbardston; Harrisville; Detroit, O. A. Farwell. Th.
776. S. balsamifera (Hook.) Barratt. Balsam Willow. Flint, Dr. D. Clark; Keweenaw Co., O. A. Farwell; near Port Huron, C. K. Dodge.
777. S. balsamifera lanceolata Bebb. Keweenaw Co., O. A. Farwell.
778. S. balsamifera vegeta Bebb. Keweenaw Co., O. A. Farwell.
*779. S. Bebbiana Sarg. Bebbs' Willow. *S. rostrata* Richardson. Moist or dry ground. Common. Th.
779a. S. Babbiana x petiolaris No. 37 Bebb. Herb. Salicum. Flint, Dr. D. Clark.
*780. S. candida Fluegge. Hoary Willow. Usually in tamarack swamps. Rare in S. part of the State. Common northward. Alma, Ann Arbor, C. A. Davis. Th.
781. S. candida x cordata Bebb. Flint, Dr. D. Clark; Hubbardston, C. F. Wheeler.
*782. S. cordata Muhl. Heart-leaved Willow. Along streams. Narrow-leaved forms occur in the central and southern parts of the State; at Petoskey, broadly ovate-heart-shaped leaved forms occur. Common. Th.
783. S. cordata angustata (Pursh.) Anders. Ypsilanti, Detroit, O. A. Farwell.
*784. S. cordata x sericea Bebb. L. H. Bailey; Flint, Dr. D. Clark.
*785. S. discolor Muhl. Glaucous Willow. River banks. Common.
786. S. eriocephala Michx. Keweenaw Co., O. A. Farwell. *S. discolor eriocephala* Anders.
789. S. fragilis L. Brittle Willow. Planted in cities and villages. Birmingham, S. Alexander.
*790. S. fragilis x alba Wimmer. Coleman's Catalogue; Palmer's Cat.
*791. S. glaucophylla Bebb. Broad-leaved Willow. Hubbardston; Petoskey, frequent along the shores of Little Traverse Bay, and shores of the Great Lakes. Rare in the interior. Th.
792. S. glaucophylla angustifolia Bebb. Sturgeon Point, Alcona Co.
793. S. glaucophylla brevifolia Bebb. Shores of Little Traverse Bay, C. F. Wheeler.
*794. S. humilis Marshall. Prairie Willow. Common northward to Marquette Co., Burt MS. Cat. A very broad-leaved form with the young leaves round obovate to nearly round, collected by O. A. Farwell, Keweenaw Co.; Ann Arbor, C. A. Davis.
*795. S. humilis x discolor Bebb. Keweenaw Co., O. A. Farwell.
795a. S. interior Rowlee. Wet places. Common. Th.
796. S. interior Wheeleri Rowlee. Bay Co., G. M. Bradford; Belle Isle, O. A. Farwell.
*797. S. lucida Muhl. Shining Willow. Along streams. Variable. Common. Th.
*798. S. myrtilloides L. Myrtle Willow. Sphagnous swamps. S. E., Winch. Cat.; Ionia to L. Superior. Frequent. Th.
799. S. myrtilloides pedicellaris Anders. Keweenaw Co., O. A. Farwell.
*800. S. nigra Marshall. Black Willow. Along streams; a small tree. Th.
801. S. nigra falcata (Pursh.) Torr. Bay City and vicinity, G. M. Bradford.
*802. S. petiolaris J. L. Smith. Petioled Willow. With the last. From Sault de Ste. Marie southward. Ionia Co. Frequent. Th.
803. S. petiolaris gracilis Anders. Slender Willow. S. western part of the State.
804. S. petiolaris x candida Bebb. Herb Salicum, No. 30. Originally from Hascall's swamp, near Flint, Mich., where it was discovered by Daniel Clarke, M. D., in 1872—the locality being soon after obliterated. Should it be deemed advisable hereafter to treat supposed hybrids as quasi-species, after the manner of Anderson, Kerner and others, I very much wish that this beautiful willow should be called S. Clarkei, to commemorate the name of a botanist who has done more than any other to give an impetus to the study of hybrid willows in this country, M. S. Bebb, 1880. Swamp near Hubbardston, Ionia Co., C. F. Wheeler.
*805. S. proinoides Pursh. *S. discolor prinoides* (Pursh.) Anders. Common.
*806. S. sericea Marshall. Silky-Willow. Drummond's Is., Winch. Cat.; Ionia Co., and southward to S. Haven, L. H. Bailey; shore of Black Lake, Cheboygan Co. Very common in central part of the State; Alma, Ann Arbor, C. A. Davis.

807. **S. sericea x candida** Bebb., *forma denudata* Bebb. Herb. Salicum; Flint, Dr. Clark.

808. **S. sericea x candida** Bebb. Herb. Salicum, No. 32. Flint, Dr. D. Clark; Hubbardston, C. F. Wheeler.

809. **S. tristis** Ait. Dwarf Gray Willow. Alcona Co.; Barron Lake, Cass Co.; Monroe Co. Infrequent.

*810. **S. viminalis** L. Basket Osier. Woodward Lake, Ionia Co.; S. Haven, L. H. Bailey.

BETULACEÆ Agardh. Birch Family.

CARPINUS L.

*811. **C. Caroliniana** Walter. American Hornbeam. Blue or Water Beech. Along streams. Th.

OSTRYA Scop.

*812. **O. Virginica** (Mill.) Willd. American Hop-Hornbeam. Lever-wood. Rich woods. Common. Th.

CORYLUS L.

*813. **C. Americana** Walt. Wild Hazel-nut. Thickets. Common. Th.

814. **C. rostrata** Ait. Beaked Hazel-nut. Hubbardston; and common northward. St. Clair Co., C. K. Dodge; Alma, C. A. Davis.

BETULA L.

815. **B. glandulosa** Michx. Dwarf Birch. Burt's MS. Cat.; Keweenaw Co., O. A. Farwell. U. P.

*816. **B. lenta** L. Cherry Birch. Sweet or Black Birch. Ann Arbor, Allmend. Cat.; S. Haven, L. H. Bailey; Lenawee Co., W. J. B.; Hubbardston; Flint and northward to L. Superior. Rare in the south, but attains a "monstrous size" on Drummond's Island, Winch. Cat. Th.

817. **B. lutea** Michx. f. Yellow or Gray Birch. Ann Arbor, Winch. Cat.; S. Haven, L. H. Bailey, to L. Superior. Common along the line of the F. & P. M. R. R. and northward to the Traverse country; a large tree south of the Grand-Saginaw valley; Alma, Ann Arbor, C. A. Davis.

*818. **B. papyrifera** Marshall. Paper or Canoe Birch. White Birch. Extends southward to Lansing and perhaps further. Frequent at Crystal Lake, Montcalm Co., as a small tree.

*819. **B. pumila** L. Low Birch. Swamps. Variable. Frequent. Th.

ALNUS Gaertn.

820. **A. Alnobetula** (Ehrh.) K. Koch. Green Alder. *A. viridis* DC. "Dry rocky land," Whitney's Cat.; Isle Royale, Dr. A. B. Lyons; high hills, Escanaba, E. J. Hill; Keweenaw Co., O. A. Farwell. Common. U. P.

*821. **A. incana** (L.) Willd. Speckled or Hoary Alder. Borders of streams. The prevailing alder in center of the State and in U. P. Common.

822. **A. rugosa** (DuRoi) K. Koch. Smooth Alder. *A. serrulata* Willd. Smooth Alder. Macomb Co.; Traverse City and S. Mich., Winch. Cat.; Burt's MS. Cat. Rare or local.

FAGACEÆ Drude. Beech Family.

FAGUS L.

*823. **F. Americana** Sweet. American Beech. *F. ferruginea* Ait. Common in L. P., but rare in U. P. Occurs at Mackinac and Pictured Rocks; St. Mary's River, Macoun. Th.

CASTANEA Adans.

824. **C. dentata** (Marsh.) Borkh. American Chestnut. *C. sativa Americana* S. Wats. Occurs abundantly along an outcrop of Helderberg limestone in E. Monroe Co. and Wayne Co., C. F. Wheeler; Ann Arbor, Dr. Steere; Detroit River to Lake St. Clair, Macoun, in Can. Cat.; St. Clair Co., C. K. Dodge. **S. E.**

QUERCUS L.

*825. **Q. acuminata** (Michx.) Houda. Chestnut or Yellow Oak. *Q. Muhlenbergii* Engelm. Rich woods. A medium sized tree. Alma, Ann Arbor, C. A. Davis. C. & S.

*826. **Q. alba** L. White Oak. Rich woods. Rare in U. P., Menominee Co., Burt. MS. Cat. Common. Th.

827. **Q. Alexanderi** Britton. Alexander's Oak. Birmingham, Oakland Co. S. Alexander; Addison, Lenawee Co., O. C. McLouth. Moist land adapted to swamp white oak, bitternut and American Elm.

828. **Q. borealis** Michx. Gray Oak. *Q. rubra borcalis* (Michx.) O. A. Farwell, similar to Red Oak. Keweenaw Co., O. A. Farwell. Referred by Elgelmann to *Q. rubra* L.

*829. **Q. coccinea** Wang. Scarlet Oak. Frequent. L. P.

830. **Q. coccinea x palustris** Hill. Detroit, O. A. Farwell. Frequent.

831. **Q. ellipsoidalis** E. J. Hill. Hill's Oak. A tall tree on moist sandy land. West of Ann Arbor, C. A. Davis.

832. **Q. imbricaria** Michx. Laurel or Shingle Oak. Barrens, Galesburg, H. Dale Adams; Ann Arbor, C. A. Davis; Sturgis, F. P. Daniels; S. Mich., Dr. Wright. Rare.

833. **Q. Leana** Nutt. *Q. imbricaria x velutina* Jackson, S. H. Camp; Ann Arbor, C. A. Davis.

*834. **Q. macrocarpa** Michx. Burr Oak. Over-cup or Mossy-cup Oak. Rich soil. Common. A form of this oak occurs in Cheboygan Co., B. & K. Lower falls of Menominee River, the farthest north of any station in the State, C. F. Wheeler. Th.

835. **Q. palustris** DuRoi. Swamp, Spanish, or Pin Oak. Only seen in the S. portion of the State; Port Huron, C. K. Dodge; Belle Isle; Monroe Co.; Jackson, Marshall, W. J. B.; Algonac, W. S. Cooper; Ypsilanti, C. A. Davis.

*836. **Q. platanoides** (Lam.) Sudw. Swamp White Oak. *Q. bicolor* Willd. Low ground. A large tree. Common. C. & S.

837. **Q. prinoides** Willd. Dwarf Chestnut Oak. A low shrub or small tree. Macomb Co.; Barron Lake, Cass Co.; Brighton, Dr. J. B. Steere; Hubbardston; Muir; Gratiot Co., Washtenaw Co., C. A. Davis. Infrequent. C. & S.

*838. **Q. rubra** L. Red Oak. In the C. & S., a large tree.

839. **Q. Schneckii** Britton. Schneck's Red Oak. *Q. Texana* Sargent. Texas Oak. Wet woods, east of Ypsilanti, C. A. Davis.

*840. **Q. velutina** Lam. Black Oak. L. P. *Q. coccinea tinctoria* A. Gray. This species and Q. coccinea occur together in the C., and are seldom large—usually 40-50 ft., and 12-15 inches in diameter.

ULMACEÆ Mirbel. Elm Family.

ULMUS L.

*841. **U. Americana** L. White or American Elm. Low grounds. Common. Th.

*842. **U. fulva** Michx. Slippery or Red Elm. Rich soil. Frequent. Th.

*843. **U. racemosa** Thomas. Cork or Rock Elm. River banks. Frequent. Th.

CELTIS L.

*844. **C. occidentalis** L. Hackberry. Sugarberry. River banks. Frequent. C. & S.

MORACEÆ Lindl. Mulberry Family.

MORUS L.

845. **M. alba** L. White Mulberry. Ypsilanti, O. A. Farwell; Birmingham, S. Alexander.

*846. **M. rubra** L. Red Mulberry. A small tree on river bottoms. Ann Arbor, C. A. Davis. C. & S.

HUMULUS L.

847. **H. Lupulus** L. Common Hop. Banks of streams. Frequent northward. Th.

CANNABIS L.

*848. **C. sativa** L. Hemp. Waste places. Frequent.

URTICACEÆ Reichenb. Nettle Family.

URTICA L.

849. **U. dioica** L. Great Nettle. Waste places. Bay Co., G. M. Bradford; Manistee, F. P. Daniels. Occasional.
*850. **U. gracilis** Ait. Slender Nettle. Moist ground. Common. Th.

URTICASTRUM Fabr. LAPORTEA Gaud.

*851. **U. divaricatum** (L.) Kuntze. Wood Nettle. *Laportea Canadensis* Gaud. Thick woods along streams. Common. C. & S.

ADICEA Raf. PILEA Lindl.

852. **A. pumila** (L.) Raf. Richweed. *Pilea pumila* A. Gray. Low woods. Common. C. & S.

BOEHMERIA Jacq.

*523. **B. cylindrica** (L.) Willd. False Nettle. Moist ground. Common. C. & S.

LORANTHACEÆ D. Don. Mistletoe Family.

RAZOUMOFSKYA Hoffm.

854. **R. pusilla** (Peck) Kuntze. Small Mistletoe. *Arceuthobium pusillum* Peck. Chatham, C. F. Wheeler; Turin, B. Barlow; south of Cadillac, C. A. Davis. Parasitic on spruces distorting the branches.

SANTALACEÆ R. Br. Sandalwood Family.

COMANDRA Nutt.

855. **C. livida** A. DC. Northern Comandra. "Sandy shores, L. Superior," A. Gray; Traverse City, Dr. A. B. Lyons; Isle Royale, Whitney Cat.; Keweenaw Co., O. A. Farwell. U. P.
*856. **C. umbellata** (L.) Nutt. Bastard Toad-flax. Dry ground. Indifferently parasitic on roots. Common. Th.

ARISTOLOCHIACEÆ Blume. Birthwort Family.

ASARUM L.

*857. **A. acuminatum** (Ashe.) Bicknell. Long-tipped Wild Ginger. Agricultural College, C. F. Wheeler; Keweenaw Co., O. A. Farwell; Alma, W. S. Cooper.
*858. **A. Canadense** L. Wild Ginger. Moist woods. Common.
*859. **A. reflexum** Bicknell. Short-lobed Wild Ginger. Muskegon, C. D. McLouth; Saginaw, W. S. Cooper; Belle Isle, O. A. Farwell.
860. **A. reflexum ambiguum** Bicknell. Keweenaw Co., O. A. Farwell.

ARISTOLOCHIA L.

861. **A. Serpentaria** L. Virginia Snakeroot. Manistee, F. P. Daniels; Detroit, O. A. Farwell. Rare.

POLYGONACEÆ Lindl. Buckwheat Family.

RUMEX L.

862. **R. Acetosa** L. Sorrel Dock. Very abundant at Point-aux-Pins, above Sault de Ste. Marie, Macoun; N. shore of Lake Superior, Pitcher, Trelease's Revision of Rumex; Bay Co., G. M. Bradford.

*863. **R. Acetosella** L. Field or Sheep Sorrel. Sterile fields. Common. Th.

*864. **R. altissimus** Wood. Pale Dock. Sault de Ste. Marie, Winch. Cat.; Ionia; near Ann Arbor, C. A. Davis. Apparently introduced at the College. Rare.

*865. **R. Britannica** L. Great Water-dock. Wet places. Ann Arbor, C. A. Davis; Ionia Co.; Flint; Macomb Co.; and northward. Frequent.

*866. **R. crispus** L. Curled Dock. Narrow Dock. Everywhere in fields. Th.

866a. **R. obtusifolius** L. Broad-leaved Dock. Th.

*867. **R. obusifolius x crispus** Trelease. North Manitou Isle., Mrs. Wislizenus. Trelease, Revision of Rumex.

*868. **R. Patientia** L. Patience Dock. Adventitious at Portland, C. F. Wheeler.

869. **R. salicifolius** Weinm. White Dock. Shore of Little Traverse Bay, and northward. Scarce. N. & U. P.

870. **R. sanguineus** L. Red-veined Dock. Introduced from Europe.

*871. **R. verticillatus** L. Swamp Dock. River banks. Frequent. L. P.

FAGOPYRUM Gaertn.

*872. **F. Fagopyrum** (L.) Karst. Buckwheat. *F. esculentum* Moench. Persistent in fields.

POLYGONUM L.

*873. **P. amphibium** L. Water Persicaria. Borders of ponds. Frequent. Th.

874. **P. arifolium** L. Halberd-leaved Tear-thumb. Low grounds. South Haven, L. H. Bailey; Gros. Cap, L. Mich. Winch. Cat.; Bay Co., G. M. Bradford; S. Mich., Wright Cat. Infrequent. L. P.

*875. **P. aviculare** L. Knot-grass. The commonest of weeds. Th.

876. **P. Careyi** Olney. Carey's Persicaria. Fort Gratiot. Dr. Z. Pitcher.

877. **P. cilinode** Michx. Fringed Black Bindweed. Copses. S. Haven, L. H. Bailey; Huron and Roscommon counties, C. A. Davis. Common northward. Th.

*878. **P. Convolvulus** L. Black Bindweed. Waste grounds. Common. Th.

*879. **P. dumetorun** L. Detroit, O. A. Farwell.

*880. **P. emersum** (Michx.) Britton. Swamp Persicaria. *P. Muhlenbergii* S. Wats. East shore of Lake Huron, J. Macoun; Ionia Co.; Flint; Grand Rapids; Indian River; Black Lake; Cheboygan Co.; Alma, Ann Arbor; C. A. Davis; S. W., H. S. Pepoon.

*881. **P. erectum** L. Erect Knot grass. Waste places. Common.

*882. **P. Hartwrightii** A. Gray. Hart Wright's Persicaria. Kalamazoo, Tuthill; Indian River; Black Lake, Cheboygan Co., B. and K.; Lenawee Co., W. J. B.; Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis.

*883. **P. Hydropiper** L. Common Smartweed or Water-pepper. Moist grounds. Common. Th.

*884. **P. hydropiperoides** Michx. Mild Water-pepper. Wet places. Common. C. & S.

885. **P. hydropiperoides Macouni** Small. Detroit, O. A. Farwell.

*886. **P. incarnatum** Ell. Slender Pink Persicaria. Frequent.

*887. **P. lapathifolium** L. Dock-leaved Persicaria. River banks. Ionia Co.; Grand Rapids, Coleman Cat.; Keweenaw Co., O. A. Farwell. Frequent.

888. **P. lapathifolium incanum** (Shmidt.) Koch. Keweenaw Co., O. A. Farwell; L. Superior, O. B. Wheeler. Th.

889. **P. lapathifolium nodosum** (Pers.) Small. Escanaba, C. F. Wheeler; Detroit, O. A. Farwell.

*890. **P. littorale** Link. Shore Knotweed. Frequent. Th.

*891. **P. orientale** L. Prince's Feather. Sparingly escaped from gardens.

*892. **P. Pennsylvanicum** L. Pennsylvania Persicaria. Low grounds. Ionia Co.; Clinton Co.; Flint; S. Mich., Wright Cat. Frequent. C. & S.

*893. **P. Persicaria** L. Lady's Thumb. Waste places. Common. Th.

*894. **P. punctatum** Ell. Water Smartweed. *P. acre* H. B. K. Wet places. Ann Arbor; Ionia Co.; Mackinac, Winch. Cat.; Flint. Frequent. L. P.

895. **P. ramosissium** Michx. Bushy Knotweed. Les Cheneaux Islands, Coryell; Alpena, C. F. Wheeler.

896. **P. Rayi** Babing. Ray's Knotweed. Belle Isle, O. A. Farwell. Frequent.

*897. **P. sagittatum** L. Arrow-leaved Tear-thumb. Low grounds. Frequent. Th.

*898. **P. scandens** L. Climbing False Buckwheat. *P. dumetorum scandens* A. Gray. Moist thickets. Frequent. Th.

*899. **P. tenue** Michx. Slender Knot-grass. Sterile soil. S. Mich., Wright Cat.; common in Ionia Co.; Macomb Co., and northward.

*900. **P. Virginianum** L. Virginia Knotweed. Thickets. Common. C. & S.

901. **P. viviparum** L. Alpine Bistort. Shore of L. Superior, A. Gray; Isle Royale, Whitney Cat.; Keweenaw Co., O. A. Farwell. Common.

POLYGONELLA Michx.

902. **P. articulata** (L.) Meisn. Coast Jointweed. Traverse City, Winch. Cat.; L. Superior, Whitney Cat.; Oscoda; Black Lake, Cheboygan Co., B. & K.; Indian River, C. F. Wheeler; Harrison, W. J. B.; Crawford Co., O. Palmer; shores of Cable Lake, Berrien Co., H. S. Pepoon. N. & U. P.

CHENOPODIACEÆ Dumort. Goosefoot Family.

CHENOPODIUM L.

*903. **C. album** L. Lamb's quarters. Pigweed. Waste and cultivated ground. Common. Th.

*904. **C. album viride** (L.) Moq. Keweenaw Co., Detroit, Ypsilanti, O. A. Farwell.

*905. **C. ambrosioides** L. Mexican Tea. Waste places. Macomb Co.; Detroit; Ann Arbor, Miss Clark; S. W., Wright. Cat. Scarce. S.

906. **C. anthelminticum** L. Wormseed. Detroit, O. A. Farwell; Port Huron, C. K. Dodge.

907. **C. Bonus-Henricus** L. Good King Henry. Flint, Dr. Clark. Infrequent.

*908. **C. Botrys** L. Jerusalem Oak. Feather Geranium. Escaped from gardens. Abundant at Indian River, C. F. Wheeler; Detroit, O. A. Farwell; Port Crescent, C. A. Davis.

*909. **C. glaucum** L. Oak-leaved Goosefoot. Detroit and Keweenaw Co., O. A. Farwell; Alma, C. A. Davis.

*910. **C. hybridum** L. Maple-leaved Goosefoot. Waste grounds. Common. Th.

911. **C. leptophyllum** (Moq.) Nutt. Narrow-leaved Goosefoot. Bay City, Charlevoix, C. F. Wheeler; Keweenaw Co., O. A. Farwell.

912. **C. murale** L. Nettle-leaved Goosefoot. Grand Rapids, Coleman Cat.; Ypsilanti and Detroit, O. A. Farwell.

913. **C. rubrum** L. Red Goosefoot. Grand Rapids, H. C. Skeels; Bay City, G. M. Bradford.

*914. **C. urbicum** L. Upright Goosefoot. Waste grounds. Ionia Co.; Flint; Grand Rapids, Coleman Cat.; Ann Arbor, C. A. Davis. Infrequent. S.

BLITUM L.

*915. **B. capitatum** L. Strawberry Blite. *Chenopodium capitatum* Aschers. Rich shady ground. Common. Th.

CYCLOLOMA Moquin.

*916. **C. atriplicifolium** (Spreng.) Coulter. Winged Pigweed. *C. platyphyllum* Moq. Keweenaw Co., O. A. Farwell; Port Huron, C. K. Dodge; Manistee, F. P. Daniels.

ATRIPLEX L.

*917. **A. hastata** L. Halberd-leaved Orache. *A. patulum hastatum* A. Gray. Common at Detroit, Dr. A. B. Lyons; Bay Co., G. M. Bradford.

918. **A. patula** L. Spreading Orache. *A. littoralis* (L.) Sturgis, F. P. Daniels; along the Great Lakes.

CORISPERMUM L.

919. C. hyssopifolium L. Bug-seed. Frankfort, C. A. Davis; Detroit, O. A. Farwell; S. Haven, L. H. Bailey; and northward to L. Superior, along the shores of the Great Lakes.

SALSOLA L.

920. S. Tragus L. Russian Thistle. *S. Kali Tragus* Moq. Well scattered over the State.

AMARANTHACEÆ J. St. Hil. Amaranth Family.

AMARANTHUS L.

*921. A. blitoides S. Wats. Prostrate Amaranth. Lately introduced from the west, spreading rapidly along railroad tracks.

*922. A. graecizans L. Tumble-weed. *A. albus* L. Fields and gardens. Frequent. Th.

923. A. hybridus L. Slender Pigweed. *A. hypochondriacus* L. *A. chlorostachys* Willd. Scarcely escaped from gardens. Ann Arbor, Miss Clark; Detroit, O. A. Farwell.

*924. A. retroflexus L. Rough Pigweed. A common weed in gardens. Th.

925. A. spinosus L. Spiny Amaranth. Detroit, O. A. Farwell.

ACNIDA L.

*926. A. tamariscina concatenata (Moq.) Uline & Bray. Frequent in Grand River Valley; Detroit, O. A. Farwell.

*927. A. tamariscina tuberculata (Moq.) Uline & Bray. Low grounds. S. Mich., Winch. Cat.; Ionia Co.; Macomb Co. Frequent. C. & S.

PHYTOLACCACEÆ Lindl. Pokeweed Family.

PHYTOLACCA L.

*928. P. decandra L. Garget. Poke. Scoke. Pigeon-berry. Fields. Frequent. C. & S.

NYCTAGINACEÆ Lindl. Four-o'clock Family.

ALLIONIA Loefl. OXYPHABUS L'Her.

929. A. hirsuta Pursh. Hairy Umbrella-wort. *Oxybaphus albidus* Choisy. Grand Rapids, C. W. Follass.

*930. A. nyctaginea Michx. Heart-leaved Umbrella-wort. *Oxybaphus nyctagineus* Sweet. Richmond, W. A. Brotherton.

AIZOACEÆ A. Br. Carpet-weed Family.

MOLLUGO L.

*931. M. verticillata L. Carpet-weed. Roadsides and sandy fields. Common. C. & S.

PORTULACACEÆ Reichenb. Purslane Family.

CLAYTONIA L.

932. C. Caroliniana Michx. Carolina Spring-beauty. Only found in the northern part of the State. Frankfort, E. J. Parker; Mackinac, July, 1888, G. H. Hicks; Keweenaw Co., O. A. Farwell; Alpena, C. A. Davis.

*933. C. Virginica L. Spring-beauty. An early and very pretty spring flower. Common. Th.

PORTULACA L.

934. P. grandiflora Hook. Garden Portulaca. Ypsilanti, Detroit, O. A. Farwell.

*935. P. oleracea L. Purslane. Pussley. Very tenacious of life—a vile weed in gardens. Very common.

CARYOPHYLLACEÆ Reich. Pink Family.

AGROSTEMMA L.

*936. **A. Githago** L. Corn Cockle. *Lychnis Githago* Scop. In wheat fields, but easily eradicated by sowing clean seed-wheat. Common.

SILENE L.

*937. **S. antirrhina** L. Sleepy Catchfly. Common.
938. **S. Armeria** L. Sweet William Catchfly. Baldwin, W. J. B.; Ypsilanti, O. A. Farwell.
*939. **S. noctiflora** L. Night-flowering Catchfly. Frequent in cultivated grounds. Th.
940. **S. stellata** (L.) Aiton. Starry Campion. Dr. Wright; Constantine, C. F. Wheeler. S.
941. **S. Virginica** L. Fire Pink. Catchfly. Winchell Cat.; Keweenaw Co., O. A. Farwell. Open woods, Lake Huron, Todd; islands in Detroit River. Maclagan, Canadian Catalogue. Th.
942. **S. vulgaris** (Moench.) Garcke. Bladder Campion. *S. Cucubalus* Wibel. Port Huron, C. K. Dodge; Manistee, F. P. Daniels.

LYNCHNIS L.

944. **L. alba** Mill. Evening Lynchnis. White Campion. *L. vespertina* Sibth. L. P. Rather common.
*945. **L. Coronaria** (L.) Desr. Mullein Pink. Keweenaw Co.; Grand Traverse, A. B. Lyons; Alma, C. A. Davis.

GYPSOPHILA L.

946. **G. muralis** L. Manistee, F. P. Daniels.

SAPONARIA L.

*947. **S. officinalis** L. Bouncing Bet. Soapwort. Waste places and roadsides. Old Mission, E. J. Hill; Keweenaw Co., O. A. Farwell. Th.

VACCARIA Medic. SAPONARIA L., in part.

*948. **V. Vaccaria** (L.) Britton. Cow-Herb. *Saponaria Vaccaria* L. Muir; S. Mich., Wright Cat.; Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge. Sparingly introduced. Th.

DIANTHUS L.

949. **D. Armeria** L. Deptford Pink. Midland, E. P. Rice; Rochester, W. A. Brotherton; Detroit, O. A. Farwell.
950. **D. barbatus** L. Sweet William. Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels; St. Clair, C. K. Dodge.
951. **D. deltoides** L. Port Huron, C. K. Dodge.

ALSINE L. STELLARIA L.

952. **A. borealis** (Bigel.) Britton. Northern Stitchwort. *Stellaria borealis* Bigelow. Point au Barques, L. Huron, and Isle aux Train, Gillman; also, Gray in Manual, and Can. Cat.; Isle Royale, A. E. Foote. Infrequent. U. P.
953. A. borealis alpestris (Fries.) Britton. *Stellaria borealis alpestris* A. Gray. Alpena, Escanaba, Marquette, C. F. Wheeler.
954. **A. crassifolia** (Ehrh.) Britton. Fleshy Stitchwort. *Stellaria crassifolia* Ehrh. Dr. Lyons; Carson City, C. F. Wheeler. Rare.
*955. **A. graminea** (L.) Britton. Lesser Starwort. *Stellaria gramminea* L. Low ground. Common. Th.
955a. **A. longifolia** (Muhl.) Britton. Long-leaved Stitchwort. Low grounds. Common. Th.
956. **A. longipes** (Goldie) Coville. *Stellaria longipes* Goldie. Long-stalked Stitchwort. Gros Cap, L. Mich., abundant in pure sand, Winch. Cat.; Lake Superior, Dr. A. B. Lyons. Rare. N. & U. P.

957. **A. media** L. Common Chickweed. *Stellaria media* Cyr. Gardens and fields. A very abundant and hardy little weed. Th.
958. **A. uliginosa** (Murr.) Britton. Bog Starwort. *Stellaria uliginosa* Murr. Dr. Lyons. Infrequent. U. P.

CERASTIUM L.

959. **C. arvense** L. Field Chickweed. Lake Superior, Can. Cat.; Mackinac, G. H. Hicks. Infrequent. Th.
960. **C. arvense oblongifolium** (Torr.) Holl. & Britt. S. Mich., Winch. Cat.; wet woods close to Amherstburgh, Ont., Macoun; Belle Isle, O. A. Farwell.
961. **C. longipedunculatum** Muhl. Nodding Chickweed. *C. nutans* Raf. Macomb Co.; Flint; Lyons; S. W., H. S. Pepoon. Found on low grounds from Louisiana to Hudson's Bay. Rare.
962. **C. semidecandrum** L. Keweenaw Co., O. A. Farwell.
963. **C. viscosum** L. Larger Mouse-ear. Th. Not common.
*964. **C. vulgatum** L. Mouse-ear Chickweed. Common. Th.

SAGINA L.

965. **S. nodosa** (L.) Fenzl. Knotted Pearlwort. L. Superior and northward A. Gray; Isle Royale, Whitney's Cat.; Keweenaw Co., O. A. Farwell; Isle Royale, F. E. Wood. U. P.
966. **S. procumbens** L. Procumbent Pearlwort. Champion, Mich., E. J. Hill.

ARENARIA L. ALSINE Wahl.

*967. **A. serpyllifolia** L. Thyme-leaved Sandwort. *Alsine serpyllifolia* L. Sandy fields. Common. Th.
967a. **A. serpyllifolia tenuior** Koch. Keweenaw Co., O. A. Farwell.
968. **A. stricta** Michx. Rock Sandwort. *Alsine Michauxii* Hook, f. S. Michigan, Wright Cat.; Macomb Co.; Montcalm Co.; L. Sup., Can. Cat.; Constantine; Three Rivers; Alcona Co.; Crystal Lake, Benzie Co. Th.

MOEHRINGIA L. ARENARIA L., in part.

*969. **M. lateriflora** (L.) Fenzl. *Arenaria lateriflora* L. St. Clair Co., C. K. Dodge.
970. **M. macrophylla** (Hook.) Torr. Lake Superior, Britton & Brown. *Arenaria macrophylla* Hook.

SPERGULA L.

971. **S. arvensis** L. Corn Spurrey. Dr. Wright; Dr. Clark; Alma, C. A. Davis. Introduced from Europe.

TISSA Adans. BUDA Adans. SPERGULARIA Pers., in part.

972. **T. rubra** (L.) Britton. Purple Sandwort. *Spergularia rubra* Presl. Litchfield, W. T. Wallace; Rochester, W. A. Brotherton.

ANYCHIA Michx.

973. **A. Canadensis** (L.) B. S. P. Norvell, C. F. Wheeler; Jonesville, W. T. Wallace.
974. **A. dichotoma** Michx. S. Mich., Dr. Wright; Ann Arbor; Watkins Sta., Dr. A. B. Lyons.

SCLERANTHUS L.

*975. **S annuus** L. Knawel. Naturalized on the Agricultural College grounds; Ann Arbor, C. A. Davis.

NYMPHAEACEÆ DC. Water Lily Family.

BRASENIA Schreber.

*976. **B. purpurea** (Michx.) Casp. Water-shield. *B. peltata* Pursh. Greenville; Ionia; Ann Arbor; Fife Lake; Oscoda; Manistee, F. P. Daniels; St. Clair, W. S. Cooper; Alma, C. A. Davis; S. W., H. S. Pepoon. Infrequent. L. P.

NYMPHAEA L. NUPHAR Sibth. & Smith.

*977. **N. advena** Soland. Large Yellow Pond Lily. *Nuphar advena* R. Br. In company with water-lilies, but often a dirty plant seeming to delight in filth. Common. Th.

978. **N. advena minor** Morong. Long Lake, Cheboygan Co., B. & K.; Baldwin, W. J. B.

979. **N. Kalmiana** (Michx.) Sims. Small Yellow Pond-Lily. *Nuphar Kalmianum* R. Br. "Sag. Bay & S. W.," Winch. Cat.; S. tier of counties, Wright's Cat.; N. shore of Lake Superior, Agassiz. Rare.

CASTALIA Salisb.

980. **C. odorata** (Dryand.) Woodv. & Wood. Sweet-scented Water-Lily. *Nymphaea odorata* Dryand. Petoskey, E. J. Hill; Vestaburg, C. A. Davis. A form with pink flowers is found in Otsego Lake, Otsego County. Infrequent.

*981. **C. tuberosa** (Paine) Greene. Tuberous White Water-Lily. *Nymphaea tuberosa* Paine. In all our ponds and slow streams. Flowers large and delicately beautiful, fragrant. Th.

NELUMBO Adans.

982. **N. lutea** (Willd.) Pers. Yellow Nelumbo. Water Chinquapin. Lotus. River Rouge, south of Detroit; Mill pond, Vicksburg, Tuthill; River Raisin at Monroe, where it is abundant. Perhaps introduced by the Indians. Local.

CERATOPHYLLACEÆ A. Gray. Hornwort Family.

CERATOPHYLLUM L.

*983. **C. demersum** L. Hornwort. Ponds. Fruit in August. Common. Th.

MAGNOLIACEÆ J. St. Hil. Magnolia Family.

LIRIODENDRON L.

*984. **L. Tulipifera** L. Tulip-tree. Whitewood. A large sized tree, frequent at Ionia, Saranac, Lansing and southward, but not seen north of Grand River Valley. Formerly common but becoming infrequent.

ANONACEÆ DC. Custard-apple Family.

ASIMINA Adans.

*985. **A. triloba** (L.) Dunal. Common Papaw. A low tree, fruit edible. Frequent in the valleys of the Grand and Maple Rivers, whence it probably reaches its northern limit. Common southward. C. & S.

RANUNCULACEÆ Juss. Crowfoot Family.

HYDRASTIS Ellis.

*986. **H. Canadensis** L. Golden Seal. Yellow Puccoon. Rich, moist woods. Rather local. C. & S.

CALTHA L.

*987. **C. palustris** L. Marsh Marigold. In swamps. Frequently called "Cowslip." Very common. Th.

TROLLIUS L.

988. **T. laxus** Salisb. American Globe Flower. Linden, A. W. Chase.

COPTIS Salisb.

*989. **C. trifolia** (L.) Salisb. Three-leaved Goldthread. Bogs and coniferous woods. Common. Th.

ISOPYRUM L.

*990. **I. biternatum** (Raf.) Torr. & Gray. False Rue Anemone. Very common on "beech and maple" land, but not on oak. C. & S.

ACTAEA L.

*991. **A. alba** (L.) Mill. White Baneberry. Cohosh. Moist woods and hillsides. Frequent. Th.

992. **A. eburnea** Rydb. Ivory Baneberry. Keweenaw Co., O. A. Farwell.

*993. **A. rubra** (Ait.) Willd. Red Baneberry. Cohosh. *A. spicata rubra* Ait. Frequent. Th.

CIMICIFUGA L.

994. **C. racemosa** (L.) Nutt. Black Snakeroot. Black Cohosh. Bugbane. S. E., Winch. Cat.; Jackson, University Herb; U. P., Burt. Rare in Michigan.

AQUILEGIA L.

*995. **A. Canadensis** L. Wild Columbine. Frequent. Th.

996. **A. vulgaris** L. European Columbine. Keweenaw Co., O. A. Farwell. Escaped from gardens.

ANEMONE L.

*997. **A. Canadensis** L. Canada Anemone. Wind-flower. *A. Pennsylvanica* L. On low ground along streams; on higher land northward. Common. Th.

*998. **A. cylindrica** A. Gray. Long-fruited Anemone. Poor soil. Infrequent. L. P.

999. **A. Hudsoniana** Richards. Cut-leaved Anemone. Mackinaw, Whitney Cat. Mouth of Saginaw R., Winchell Cat.; Lake Superior, Gray; Frankfort; shore of Grand Traverse Bay, and Torch Lake near the landing, E. J. Hill; eight miles below Rock Harbor, Isle Royal, Porter; Bay Co., Tuscola Co., C. A. Davis. Has been confused with *A. multifida* Poir; a South American species.

1000. **A. parviflora** Michx. Northern Anemone. Dr. Lyons; Asa Gray; Pic River, Lake Superior, Macoun. Rare. U. P.

*1001. **A. quinquefolia** L. Wind-flower. Wood Anemone. *A. nemorosa* Michx. Bay Co., G. M. Bradford. Common. Th.

1002. **A. riparia** Fernald. Rochester and Detroit, O. A. Farwell.

*1003. **A. Virginiana** L. Frequent, preferring sand or gravel. Th.

HEPATICA Scop.

*1004. **H. acuta** (Pursh.) Britton. Sharp-lobed Liver-leaf. This species is very common on beech and maple land, while *Hepatica Hepatica* prefers oak soil. Th.

*1005. **H. Hepatica** (L.) Karst. Round-lobed Liver-leaf. *H. triloba* Chaix. Less frequent than the preceding, at least in the center. Th.

SYNDESMON Hoffmg. ANEMONELLA Spach.

*1006. **S. thalictroides** (L.) Hoffmg. Rue-Anemone. *Anemonella thalictroides* Spach. Quite local through C. & S.; Keweenaw Co., O. A. Farwell; Sturgis, F. P. Daniels; Ann Arbor, C. A. Davis.

PULSATILLA Adans.

1007. **P. hirsutissima** (Pursh.) Britton. Nuttall's Pasque Flower. *Anemone patens Nuttalliana* A. Gray. Norway, S. M. Tobey. Infrequent.

CLEMATIS L.

*1008. **C. Virginiana** L. Common Virgin's Bower. Frequent on low land. Th.

ATRAGENE L.

1009. **A. Americana** Sims. Purple Virgin's Bower. *Clematis verticillaris* DC. Norway, S. M. Tobey. Rare.

RANUNCULUS L.

*1010. **R. abortivus** L. Small-flowered Crowfoot. Common. Th.

*1011. **R. acris** L. Tall Crowfoot or Buttercup. "Classed by Hooker f. as indigenous." S. Watson. So. Haven; Macomb Co.; Flint; Huron shore, Winch. Cat.; and Lake Superior. Gradually spreading over the State. Infrequent. Th.

1012. **R. bulbosus** L. Bulbous Crowfoot or Buttercup. Sault Ste. Marie, Porter; Bay Co., G. M. Bradford; Keweenaw Co., O. A. Farwell. A bad weed in meadows.

*1013. **R. delphinifolius** Torr. Yellow Water-Crowfoot. *R. multifidus* Pursh. Ponds and slow streams. Perennial by rooting from the nodes of floating stems after flowering. The young plants rooting in mud are pubescent so far as observed in many parts of the State. Common. Th.

*1014. **R. fascicularis** Muhl. Early Crowfoot. Flowers sometimes double or with reversion of essential organs to leaves. Ann Arbor, C. A. Davis; Berrien Co., H. S. Pepoon. Hills and sandy plains. Infrequent from the center of the State southward.

1015. **R. Lapponicus** L. Lapland Buttercup. Thunder Bay, Lake Superior, Britton & Brown.

1016. **R. Macounii** Britton. Macoun's Buttercup. *R. hispidus* Hook. Lake Superior, Britton and Brown.

1017. **R. micranthus** Nutt. Rock Crowfoot. *R. obortivus micranthus* A. Gary. North shore of Lake Superior, Agassiz; Keweenaw Co., O. A. Farwell.

1018. **R. obtusiusculus** Raf. Water Plantain Spearwort. *R. ambigens* S. Wats. Dr. Lyons. St. Clair Co., A. F. Foerste and W. S. Cooper.

1019. **R. ovalis** Raf. Prairie Crowfoot. *R. rhomboideus* Goldie. On light sand; Muir and Palo in Ionia County; Lake Superior, Can. Cat. Prairies, Mich. A. Gray. Rare.

1020. **R. Pennsylvanicus** L. f. Bristly Crowfoot. Frequent on low land. Th.

1021. **R. Purshii** Richards. Pursh's Buttercup. Topinabee, S. H. Camp; Chandler's Falls, Atlanta; Alpena, C. F. Wheeler.

*1022. **R. recurvatus** Poir. Hooked Crowfoot. Woods in rich soil. Common. Th.

*1023. **R. repens** L. Creeping Buttercup. Port Huron, C. K. Dodge; Rochester, W. A. Brotherton and O. A. Farwell; Montreal River, Keweenaw Co., O. A. Farwell; in the lawn Agricultural College, C. F. Wheeler.

1024. **R. reptans** L. Creeping Spearwort. *R. Flammula reptans* E. Meyer. Infrequent except northward, and not seen in the center of the State. Sandy shore of Black Lake, Cheboygan Co., B. & K.; Belle Isle, O. A. Farwell; Algonac, W. S. Cooper. N. U. P.

1025. **R. reptans intermedius** (Hook.) Torr. & Gray. *R. Flammula intermedius* Hook. Keweenaw Co., O. A. Farwell.

*1026. **R. sceleratus** L. Cursed Crowfoot. Ditch Crowfoot. Ditches and low ground. Exceedingly variable, stems sometimes two inches in diameter. Frequent. Th.

*1027. **R. septentrionalis** Poir. Swamp Buttercup. Frequent and variable. Th.

BATRACHIUM S. F. Gray.

*1028. **B. divaricatum** (Schrank) Wimm. Stiff Water-Crowfoot. *Ranunculus circinatus* Sibth. Bear River, Petoskey, E. J. Hill; Ann Arbor, Allmendinger Cat.; Huron R., Lyons. The common form in L. P. Frequent. Th.

1029. **B. trichophyllum** (Chaix.) Bossch. White Water-Crowfoot. *Ranunculus aquatilis trichophyllus* A. Gray. Common. Not observed in E. and S. Black Lake, Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell, St. Clair River and Lake, W. S. Cooper.

OXYGRAPHIS Bunge.

1030. **O. Cymbalaria** (Pursh.) Prantl. Seaside Crowfoot. *Ranunculus Cymbalaria* Pursh. South Haven, L. H. Bailey. Rare.

THALICTRUM L.

*1031. **T. dioicum** L. Early Meadow-Rue. Common along river banks. Th.

1032. **T. polygamum** Muhl. Tall Meadow-Rue. Keweenaw Co., O. A. Farwell.

*1033. **T. purpurascens** L. Purplish Meadow-Rue. Wet meadows. Common. Th.

NIGELLA L.

1033a. N. Damascena L. Fennel-flower. Escaped from gardens. Infrequent.

BERBERIDACEÆ T. G. Barberry Family.

BERBERIS L.

*1034. B. vulgaris L. Common Barberry. Sometimes escaped from cultivation; Flint, Dr. Clark; Tuscola Co., Ann Arbor, C. A. Davis; Bay Co., G. M. Bradford.

CAULOPHYLLUM Michx.

*1035. C. thalictroides (L.) Michx. Pappoose-root. Blue Cohosh. Common in L. P.

JEFFERSONIA Barton.

*1036. J. diphylla (L.) Persoon. Rheumatism-root. Twin-leaf. Infrequent. C. & S.

PODOPHYLLUM L.

*1037. P. pelatum L. May-Apple. Wild Mandrake. Very common. C. & S.

MENISPERMACEÆ DC. Moonseed Family.

MENISPERMUM L.

*1038. M. Canadense L. Canada Moonseed. Woods and moist thickets. Frequent.

LAURACEÆ Lindl. Laurel Family.

SASSAFRAS Nees & Eberm.

*1039. S. Sassafras (L.) Karst. Sassafras. *S. officinale* Nees & Eberm. Woods, sandy soil, Manistee, F. P. Daniels; Hamlin Lake, Mason Co., C. E. St. Johns; Bay Co., G. M. Bradford. Frequent. L. P.

BENZOIN Fabric.

*1040. B. Benzoin (L.) Coulter. Spice-bush. *Lindera Benzoin* Blume. Damp woods. Frequent. C. & S.

PAPAVERACEÆ B. Juss. Poppy Family.

Including also Fumariaceæ.

PAPAVER L.

1041. P. somniferum L. Common Poppy. Opium Poppy. Occasional. Escaped from cultivation.

SANGUINARIA L.

*1042. S. Canadensis L. Bloodroot. Common. Th.

STYLOPHORUM Nutt.

1043. S. diphyllum (Michx.) Nutt. Celandine Poppy. Rich woods, Oceana County and southward. Local. C. & S.

CHELIDONIUM L.

*1044. C. majus L. Celandine. Lebanon, Clinton Co., Van Vleck; Sturgis, F. P. Daniels.

BICUCULLA Adans. DICENTRA Bernh.

*1045. **B. Canadensis** (Goldie) Millsp. Squirrel Corn. *Dicentra Canadensis* Walp. From Frankfort southward. Frequent. L. P.

*1046. **B. Cucullaria** (L.) Millsp. Dutchman's Breeches. *Dicentra cucullaria* Torr. Frankfort, southward. Frequent. L. P.

ADLUMIA Raf.

1047. **A. fungosa** (Ait.) Greene. Climbing Fumitory. *A. cirrhosa* Raf. Hemlock woods in vicinity of Houghton Lake; Grand Rapids, Miss Clark; So. Haven; Marquette, E. J. Hill. Not common. Th.

CAPNOIDES Adans. CORYDALIS Vent.

1048. **C. aureum** (Willd.) Kuntze. Golden Corydalis. *Corydalis aurea* Willd. Sturgis, F. P. Daniels. Frequent northward in the U. P. Common.

1049. **C. sempervirens** (L.) Borck. Pale Corydalis. *Corydalis glauca* Pursh. Grand Haven; Clare Co.; L. Sup. Infrequent except northward. Oscoda; Alger's camp, Alcona Co. Th.

FUMARIA L.

1050. **F. officinalis** L. Fumitory. Escaped from cultivation at Ypsilanti. O. A. Farwell.

CRUCIFERÆ B. Juss. Mustard Family.

LEPIDIUM L.

*1051. **L. apetalum** Willd. Apetalous Pepper-grass. *L. intermedium* A. Gray. Alma, Ann Arbor, C. A. Davis; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.

1052. **L. campestre** (L.) R. Br. Field or Cow Cress. Bay Co., G. M. Bradford; Macomb Co., and Detroit. Infrequent. S. E.

1053. **L. sativum** L. Garden Pepper-grass. Port Huron, C. K. Dodge. Escaped from cultivation.

*1054. **L. Virginicum** L. Wild Pepper-grass. Alma, Ann Arbor. Th.

IBERIS L.

1055. **L. amara** L. Escaped from gardens. Keweenaw Co., O. A. Farwell.

CONRINGIA Link.

1056. **C. orientalis** (L.) Dumort. A bad weed in grain fields, introduced into northern Michigan from the northwest. O. A. Farwell.

THLASPI L.

*1057. **T. arvense** L. Field Pennycress. Ann Arbor. Allmendinger Cat.; "shore of Lake Huron," A. Gray; Monroe, C. A. Davis; Bay Co., G. M. Bradford.

SISYMBRIUM L.

1058. **S. altissimum** L. Tall Sisymbrium. A bad weed from Europe introduced into the Canadian Northwest. Benton Harbor in 1896, C. F. W.; later in many localities. Tuscola Co., C. A. Davis; near Detroit, O. A. Farwell.

1059. **S. humile** Meyer. Northern Rock-cress. Isle Royale, Gillman; Keweenaw Co., O. A. Farwell; Mackinac, G. H. Hicks; Macomb Co.; Grand Haven. Infrequent.

*1060. **S. officinale** (L.) Scop. Hedge Mustard. Road-sides and wet places. Frequent. Th.

CAKILE Gaertn.

1061. **C. edentula** (Bigel.) Hook. Sea-rocket. *C. Americana* Nutt. Shores of the great lakes. Common. Th.

SINAPIS L.

*1062. **S. alba** L. White Mustard. *Brassica alba* Boiss. Infrequent. Th.

BRASSICA L.

*1063. **B. arvensis** (L.) B. S. P. Charlock. *Brassica Sinapistrum* Boiss. A bad weed, becoming too frequent. Th.

1064. **B. campestris** L. Turnip. Keweenaw Co., O. A. Farwell.

*1065. **B. juncea** (L.) Cosson. Indian Mustard. Lapeer, Mrs. M. Owen; Keweenaw Co., O. A. Farwell; Port Huron, W. S. Cooper.

*1066. **B. nigra** (L.) Koch. Black Mustard. Common. Th.

DIPLOTAXIS DC.

*1067. **D muralis** (L.) DC. Sand Rocket. Grand Rapids, H. C. Skeels.

RAPHANUS L.

1067a. **R. Raphanistrum** L. White Charlock. Ballast grounds. Detroit, O. A. Farwell.

1067b. **R. sativus** L. Garden Radish. Persists for some time in old gardens and waste places.

BARBAREA R. Br.

1069. **B. Barbarea** (L.) MacM. Yellow Rocket or Cress. *B. vulgaris* R. Br. South Haven; Ann Arbor, Allmendinger Cat.; Macomb Co.; Alma, C. A. Davis; Hubbardston; Bay Co., G. M. Bradford; and N. into the U. P. where it is indigenous and frequent. Th.

1070. **B. praecox** (J. E. Smith) R. Br. Belle Isle Cress. Sandy ground. St. Clair Co., C. K. Dodge.

1071. **B. stricta** Andrz. Erect-fruited Winter Cress. *B. vulgaris stricta* A. Gray. Keweenaw Co., O. A. Farwell; St. Clair Co. near Capac, C. K. Dodge; Detroit, W. S. Cooper.

RORIPA Scop. NASTURTIUM R. Br.

1072. **R. Americana** (A. Gray) Britton. Lake Water-cress. *Nasturtium lacustre* A. Gray. From Fish Creek and Maple River southward. Infrequent. C. & S.

*1073. **R. Armoracia** (L.) Hitchcock. Horseradish. *Nasturtium Armoracia* Fries. Escaped from gardens into waste places. Frequent.

*1074. **R. hispida** (Desv.) Britton. Hispid Yellow Cress. *Nasturtium palustre hispidum* A. Gray. Alma, Ann Arbor, C. A. Davis. Th.

*1075. **R. Nasturtium** (L.) Rusby. True Water-cress. *Nasturtium officinale* R. Br. Ionia; South Haven; Ann Arbor, Alma, C. A. Davis. Frequent in brooks.

1076. **R. obtusa** (Nutt.) Britton. Blunt-leaved Yellow Cress. *Nasturtium obtusum* Nutt. Keweenaw Co., O. A. Farwell.

*1077. **R. palustris** (L.) Bess. Yellow Water-cress. *N. palustre* DC. Frequent. Th.

1078. **R. sylvestris** (L.) Bess. Creeping Yellow Water-cress. *Nasturtium sylvestre* R. Br. Detroit; O. A. Farwell.

CARDAMINE L.

*1079. **C. bulbosa** (Schreb.) B. S. P. Bulbous Cress. *C. rhomboidea* DC. Common. Th.

*1080. **C. hirsuta** L. Small Bitter Cress. New Buffalo, C. F. Wheeler; near Black Lake, Cheboygan Co., B. & K.; Belle Isle, O. A. Farwell; Alma, C. A. Davis. Th.

1081. **C. parviflora** L. Small-flowered Bitter-cress. New Buffalo, C. F. W.; Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; St. Clair Co., J. W. Stacey.

1082. **C. Pennsylvanica** Muhl. Pennsylvania Bitter-cress. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford.

*1083. **C. pratensis** L. Cuckoo-Flower. Bogs. Rare S., frequent in C., and common N. Th.

*1084. **C. purpurea** (Torr.) Britton. Purple Cress. *C. rhomboidea purpurea* DC. An early spring flower. Th.

MATTHIOLA L.

1085. **M. bicornis** (B. & S.) DC. Growing in sand along shore of Lake Huron. U. S. Dept. of Agriculture reported it as the only place in the country where it had escaped.

DENTARIA L.

*1086. **D. diphylla** Michx. Two-leaved Toothwort. Common. Th.
*1087. **D. laciniata** Muhl. Cut-leaved Toothwort. Keweenaw Co. and southward. Common. Th.
1088. **D. maxima** Nutt. Large Toothwort. Bluffs along Black River near Abbottsford, C. K. Dodge; the only station known in the State.

BURSA Weber. CAPSELLA Medic.

*1089. **B. Bursa-pastoris** (L.) Britton. Shepherd's Purse. *Capsella Bursa-pastoris* Medic. The commonest of weeds. Th.

CAMELINA Crantz.

*1090. **C. microcarpa** Andrz. Small-fruited False Flax. A weed which is becoming naturalized from Europe.
1091. **C. sativa** (L.) Crantz. Gold-of-Pleasure. False Flax. Road-sides and waste places. Flint; Ann Arbor; Macomb Co.; Sturgis; Bay Co.; Keweenaw Co., F. Not common. Th.

DRABA L.

1092. **D. Caroliniana** Walt. Carolina Whitlow-grass. Ionia Co. and southward. Rare. C. & S.
1093. **D. incana arabisans** (Michx.) S. Wats. Shores of Great Lakes. Mackinac, G. H. Hicks. Infrequent.
*1094. **D. nemorosa** L. Wood Whitlow-grass. "Fort Gratiot and northwestward." A. Gray. Collected by Dr. Pitcher. Infrequent.
*1095. **D. verna** L. Whitlow-grass. S. W., H. S. Pepoon; Detroit, Dr. Lyons. Rare. S.

SOPHIA Adans.

1096. **S. pinnata** (Walt.) Britt. Tansy Mustard. *Sisymbrium canescens* Nutt. Shores of Great Lakes, Pitcher, Houghton, Winchell; Barry Co., L. H. Bailey. Infrequent. Th.
1096a. **S. pinnata brachycarpa** (Richards) O. A. Farwell. Belle Isle, O. A. Farwell.
1097. **S. Sophia** (L.) Britton. Flixweed. Keweenaw Co., O. A. Farwell.

ARABIS L.

1098. **A. brachycarpa** (T. & G.) Britton. Purple Rock-cress. *A. confinis brachycarpa* Watson and Coulter. Keweenaw Co., O. A. Farwell; Marquette, Alpena, Hubbardston, C. F. Wheeler. Not common.
*1099. **A. Canadensis** L. Sickle-pod. Fields and rocky woods. Not common.
*1100. **A. dentata** T. & G. Toothed Rock-cress. Low lands along Grand River and southward. Not common. C. & S.
1100a. **A. Drummondii** A. Gray. *A. confinis* S. Wats., in part. Keweenaw Co., O. A. Farwell.
*1101. **A. glabra** (L.) Bernh. Tower Mustard. *A. perfoliata* Lam. Alma, Ann Arbor, C. A. Davis. Fields. Infrequent. Th.
*1102. **A. hirsuta** (L.) Scop. West Bay City, G. M. Bradford.
1103. **A. Holboellii** Hornem. Holboell's Rock-cress. Thunder Bay, Alpena Co., the most easterly known station for this western species, C. F. Wheeler.
*1104. **A. laevigata** (Muhl.) Poir. Smooth Rock-cress. River banks. Infrequent. Th.
1105. **A. lyrata** L. Lyre-leaved Rock-cress. Sandy fields, Hubbardston; South Haven; Flint; Petoskey; U. P., Whitney Cat. Infrequent. Th.
1106. **A. lyrata occidentaliss** S. Wats. Bower's Harbor, Grand Traverse Bay, Alpena, C. F. Wheeler.

ERYSIMUM L.

*1107. **E. cheiranthoides** L. Worm-seed Mustard. Gratiot Co.; Grayling, G. H. Hicks; Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; Port Huron, C. K. Dodge; Alma, Ann Arbor, C. A. Davis.
*1108. **E. inconspicuum** (S. Wats.) MacM. Small Erysimum. *E. parviflorum* Nutt. Probably introduced from the west. Clifton, Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge.

ALYSSUM L.

*1109. **A. alyssoides** (L.) Gouan. Yellow Alyssum. *A. calycinum* L. Hubbardston, Ionia, Flint, C. F. Wheeler; Alma, Ann Arbor, C. A. Davis; Bay Co., G. M. Bradford. A recently introduced plant, becoming common in many localities. Door-yards and waste places.

HESPERIS L.

1110. **H. matronalis** L. Dame's Violet. Escaped from cultivation at Cassopolis, C. F. Wheeler; shore of Lake Huron, T. & G.; Ann Arbor, C. A. Davis; Keweenaw Co., Ypsilanti, O. A. Farwell.

CAPPARIDACEÆ Lindl. Caper Family.

CLEOME L.

1111. **C. serrulata** Pursh. Pink Cleome. *C. integrifolia* T. & G. Vestaburg, C. A. Davis. At one time introduced in several places near the Agricultural College, but now apparently extinct.

POLANISIA Raf.

1112. **P. graveolens** Raf. Clammy-weed. Shores of Great Lakes; Bay Co., G. M. Bradford; South Haven; Detroit; Put-in-Bay. Not rare.

RESEDACEÆ S. F. Gray. Mignonette Family.

RESEDA L.

1113. **R. lutea** L. Yellow cut-leaved Mignonette. Jackson, S. H. Camp.

SARRACENIACEÆ La Pyl. Pitcher-Plant Family.

SARRACENIA L.

1114. **S. purpurea** L. Side-saddle Flower. Huntsman's Cup. Pitcher-plant. Common in sphagnous swamps. Th.

1115. **S. purpurea heterophylla** (Eaton) Torr. Keweenaw Co., O. A. Farwell.

DROSERACEÆ S. F. Gray. Sundew Family.

DROSERA L.

1116. **D. intermedia** Hayne. Spatulate-leaved Sundew. ***D. intermedia*** var. *Americana* DC. S. Mich., Wright, Cat.; Ann Arbor, Allmendinger Cat.; Grand Rapids, R. H. Wolcott; Keweenaw Co., O. A. Farwell; Vestaburg, C. A. Davis. Th.

1117. **D. linearis** Goldie. Slender Sundew. Livingston Co.; L. Superior, Dr. Lyons; Keweenaw Co., O. A. Farwell; La Pointe, D. Houghton; Copper Harbor, F. E. Wood. Rare.

1118. **D. longifolia** L. Oblong-leaved Sundew. Mud Lake, Oakland Co., W. A. Brotherton.

*1119. **D. rotundifolia** L. Round-leaved Sundew. In sphagnous swamps. An insectivorous plant. Th.

PODOSTEMACEÆ Lindl. River-Weed Family.

PODOSTEMON Michx.

1120. **P. Ceratophyllum** Michx. River-weed. Thread-foot. Detroit, Dr. A. B. Lyons.

CRASSULACEÆ DC. Orpine Family.

SEDUM L.

*1121. **S. acre** L. Mossy Stone-crop. Escaped from cultivation; Alma, Whitmore Lake, C. A. Davis; Bay Co., G. M. Bradford: Keweenaw Co., O. A. Farwell.

*1122. **S. Telephium** L. Live-forever. Garden Orpine. Escaped from cultivation. Th.

PENTHORACEÆ Rydb.

PENTHORUM L.

*1123. **P. sedoides** L. Ditch Stonecrop. Roadsides and ditches; shore of Black Lake, Cheboygan Co., B. & K. Frequent. L. P.

SAXIFRAGACEÆ Dumort. Saxifrage Family.

SAXIFRAGA L.

1124. **S. autumnalis** L. Yellow Mountain Saxifrage. *S. aizoides* L. Northern Michigan, A. Gray; Britton & Brown. U. P.

1125. **S. Aizoon** Jacq. Livelong Saxifrage. Upper Mich., Gray; Isle Royale, Lyons, and Whitney. U. P.

*1126. **S. Pennsylvanica** L. Swamp Saxifrage. Bogs. Common. Th.

1127. **S. tricuspidata** Retz. Three-toothed Saxifrage. Shore of L. Superior and northward, A. Gray; Isle Royale, Dr. Lyons and Whitney Cat. U. P.

1128. **S. Virginiensis** Michx. Early Saxifrage. L. Superior, Can. Cat.; Keweenaw Co., O. A. Farwell. U. P.

TIARELLA L.

*1129. **T. cordifolia** L. False Mitrewort. Birmingham, Belle Isle, O. A. Farwell; Ft. Gratiot; Macomb Co.; Flint; Stanton, and northward. Common in N. & U. P.; rare in C. & S. W. Th.

HEUCHERA L.

1130. **H. Americana** L. Common Alum-root. Grand Rapids, Coleman; Ann Arbor, Winch. Cat.; Monroe Co., C. F. Wheeler; Ypsilanti, O. A. Farwell. C. & S.

*1131. **H. hispida** Pursh. Common in Grand-Saginaw Valley; Ypsilanti, O. A Farwell C. & S.

MITELLA L.

*1132. **M. diphylla** L. Mitre-wort. Hillsides in rich woods. Very common. Th.

*1133. **M. nuda** L. Shaded swamps in Sphagnum. Frequent. Th.

CHRYSOSPLENIUM L.

*1134. **C. Americanum** Schwein. South Haven; Hubbardston; Flint; Alma, C. A. Davis. Northward. Infrequent.

PARNASSIACEÆ Dumort. Grass-of-Parnassus Family.

PARNASSIA L.

*1135. **P. Caroliniana** Michx. Alma, C. A. Davis. Swamps and wet banks. Rare northward; common in C. & S.

1136. **P. palustris** L. Drummond's Is., Winch. Cat.; "shore of L. Superior and northward," A. Gray, from Dr. Pitcher; Harbor Point, C. A. Davis; Keweenaw Co., O. A. Farwell.

1137. **P. parviflora** DC. L. Sup., Can. Cat.; Grand Island, Henry Gillman; Harbor Point, C. A. Davis; also, northwest shore of Lake Michigan, in Wisconsin, Gillman. U. P.

GROSSULARIACEÆ Dumort. Gooseberry Family.

RIBES L.

1138. **R. aureum** Pursh. Permanently established on shore of Lake Huron, C. K. Dodge.

*1139. **R. Cynosbati** L. Gooseberry. Common. Th.

*1140. **R. floridum** L'Her. Wild Black Currant. Cheboygan Co., B. & K. Southward. Common. Th.

*1141. **R. gracile** Michx. Slender Gooseberry. St. Joseph's Island, and Sitting Rabbit, Winchell's Cat.; Chandler's, C. F. Wheeler.

1142. **R. lactustre** (Pers.) Poir. Swamp Gooseberry. As far south as Houghton Lake; Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell.

*1143. **R. oxyacanthoides** L. Swamp Gooseberry. Low grounds along Fish Creek and Maple River; Flint; Macomb Co., northward and shore of Long Lake, B. & K.; Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis; Bay Co., G. M. Bradford.

1144. **R. prostratum** L'Her. Fetid Currant. Flint; Isabella Co.; Missaukee Co.; St. Joseph's Is., Winch. Cat.; Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell. Frequent. C. N. & P.

1145. **R. rotundifolium** Michx. Thunder Bay Island, C. F. Wheeler.

*1146. **R. rubrum** L. Red Currant. Deep swamps and cold woods, under tamaracks. Ann Arbor; Ionia; Stanton; Cheboygan Co., B. & K. Infrequent. Th.

HAMAMELIDACEÆ Lindl. Witch Hazel Family.

HAMAMELIS L.

*1147. **H. Virginiana** L. Common. Th.

PLATANACEÆ Lindl. Plane-Tree Family.

PLATANUS L.

*1148. **P. occidentalis** L. Along our rivers. "The largest tree of the Atlantic forests." Sargent. C. & S.

ROSACEÆ B. Juss Rose Family.

OPULASTER Medic. PHYSOCARPA Raf.

1149. **O. opulifolius** (L.) Kuntze. Ninebark. *Physocarpus opulifolius* Maxim. Along streams. Th.

SPIRAEA L.

*1150. **S. salicifolia** L. Common Meadow-Sweet. In marshes. Common. Th.

1151. **S. sorbifolia** L. Port Huron, C. K. Dodge.

*1152. **S. tomentosa** L. Hardhack. Steeple-bush. Grand Rapids, G. D. Sones; north of the College about three and one-half miles, W. J. B.; Sturgis, F. P. Daniels; Ann Arbor, C. A. Davis; Ionia Co., and southward. Infrequent. C. & S.

PORTERANTHUS Britton. GILLENIA Moench.

1152a. **P stipulatus** (Muhl.) Britton. Near Detroit, O. A. Farwell.

1153. **P. trifoliatus** (L.) Britton. Indian Physic. *Gillenia trifoliata* Moench. Bowman's Root. Winchell Cat. Rare. S.

RUBUS L.

*1154. **R. Americanus** (Pers.) O. A. F. Dwarf Raspberry. *R. triflorus* Richard. Frequent. Th.

1154a. **R. argutus** Link. Tall Blackberry. Keweenaw Co., O. A. Farwell.

*1155. **B. Baileyanus** Britton. Belle Isle. O. A. Farwell.

*1156. **R. Canadensis** L. Dewberry. Low Blackberry. *R. Millspaughii* Britt. Lake, Cheboygan Co., C. F. Wheeler; Alma, Ann Arbor, C. A. Davis; Keweenaw Co., O. A. Farwell. Black. Frequent. Th.

1157. **R. Ensleni** Tratt. Enslen's Dewberry. Detroit and vicinity, O. A. Farwell.

1157a. **R. frondosus** Bigel. Leafy-bracted Blackberry. *R. villosus frondosus* Bigel. Keweenaw Co., and Detroit, O. A. Farwell.

*1158. **R. hispidus** L. Running Swamp-B. Very abundant through the central in the pine country. Th.

*1160. **R. neglectus** Peck. Hubbardston; Birmingham; Belle Isle; Alma, C. A. Davis.

1161. **R. nigricans** Rydb. Peck's Dewberry. Detroit and vicinity, O. A. Farwell.

*1161a. **R. nigrobaccus** Bailey. High Bush Blackberry. *R. villosus* A. Gray. Very common in Central Mich., rare in U. P.

*1162. **R. occidentalis** L. Black R. Thimbleberry. Hybrids between this and *R. strigosus* frequently occur. Common. Th.

1163. **R. odoratus** L. Purple Flowering Raspberry. From Ft. Gratiot (Winchell) northward. Not observed in the interior of the C. & S. Common in N. and U. P. Th.

1164. **R. parviflorus** Nutt. Salmon-berry. *R. Nutkanus* Mocino. Salmon-berry. Frequent at Petoskey and common farther north; Elk Rapids, W. S. Cooper. N. & U. P.

1164a. **R. procumbens** Muhl. Low Running Blackberry. *R. Canadensis* T. & G., not L. Keweenaw Co., Detroit, O. A. Farwell.

*1165. **R. setosus** Bigel. Bristly Blackberry. Vestaburg, C. F. Wheeler.

*1166. **R. strigosus** Michx. Wild Red Raspberry. Variable. Common. Th.

DALIBARDA L.

1169. **D. repens** L. Ann Arbor, Mary Clark; Macomb Co., Cooley. May occur farther north, and perhaps throughout. Lake Huron, Bell, Canadian Catalogue.

DRYMOCALLIS Fourr. POTENTILLA, in part.

*1170. **D. arguta** (Pursh.) Rydb. Tall Cinquefoil. *Potentilla argnta* Pursh. Flowers either white or yellow, generally all in one locality of one color. Alma; Ann Arbor; Macomb Co.; Ionia; and N. to Isle Royal. Frequent on light sand; in places common. Th.

DASIPHORA Raf. POTENTILLA, in part.

*1171. **D. fruticosa** (L.) Rydb. Shrubby Cinquefoil. *Potentilla fruticosa* L. Edges of swamps. Ranges N. to Arctic America. Common. Th.

SIBBALDIOPSIS Rydb. POTENTILLA, in part.

1172. **S. tridentata** (Soland.) Rydb. Three-toothed Cinquefoil. *Potentilla tridentata* Soland. Barrens of Missaukee Co.; Grayling; shores of the Upper Great Lakes, A. Gray; Isle Royal, Dr. Lyons; Roscommon, C. A. Davis. N. & U. P. Frequent.

FRAGARIA L.

1173. **F. Americana** (Porter) Britton. American Wood Strawberry. *F. vesca Americana* T. G. Porter. Keweenaw Co., O. A. Farwell; Baldwin, W. J. B.; Vestaburg, C. A. Davis; Alpena, C. F. Wheeler.

1174. **F. Canadensis** Michx. Northern Wild Strawberry. N.

*1175. **F. Virginiana** Duchesne. Virginia Strawberry. *F. Virginiana Illinoensis* Prince. Common. Th.

COMARUM L. POTENTILLA, in part.

*1176. **C. palustre** (L.) Marsh Cinquefoil. *Potentilla plustris* Scop. Swamps throughout, but nowhere abundant.

ARGENTINA Lam. POTENTILLA, in part.

1177. **A. Anserina** (L.) Rydb. *Potentilla Anserina* L. Silver-weed. Frequent along the Great Lakes, but rare in the interior. Banks of Higgins Lake, G. H. Cannon; Baldwin, W. J. B.; Otsego Co., Guy L. Stewart; Huron Co., C. A. Davis.

POTENTILLA L.

*1178. **P. argentea** L. Silvery Cinquefoil. Ann Arbor, Clark and Allmendinger; Alma, Davis; Inland, Benzie Co.; Behaves like a weed at Hanover, Mich., running out clover, G. E. Simmons; St. Clair Co., C. K. Dodge.

*1179. **P. Canadensis** L. Common Cinquefoil. Five-finger. Common. Th.

1180. **P. intermedia** L. Downy Cinquefoil. Well established in Livingston and Washtenaw counties, C. F. Wheeler.

1181. **P. Monspeliensis** L. Rough Cinquefoil. *P. Norvegica* L. Common. Th.

1182. **P. paradoxa** Nutt. Bushy Cinquefoil. Shores of Great Lakes.

1183. **P. Pennsylvanica** L. L. Superior, Gray's Man. Prof. Ellis, in Canadian Catalogue.

1184. **P. Robbinsiana** Oakes. Robbin's Cinquefoil. *P. frigida* A. Gray. (Not Villar.) Dr. Lyons. Rare. U. P.

*1185. **P. sulphurea** Lam. Much like *P. recta* L. Ypsilanti, O. A. Farwell; Howell Junction, C. F. Wheeler.

WALDSTEINIA Willd.

*1186. **W. fragarioides** (Michx.) Tratt. Barren Strawberry. Livingston Co., Winch. Cat.: Ionia; Flint to L. Sup., Whitney Cat. Rather local, but abundant when found at all. Th.

GEUM L.

*1187. **G. Canadense** Jacq. White Avens. *G. album* Gmelin. Common. L. P.

1188. **G. macrophyllum** Willd. Rare in L. P. Cheboygan Co., B. & K.; N. shore of Lake Superior, Agassiz.

*1189. **G. rivale** L. Water or Purple Avens. Swamps and wet places. Common. Th.

1190. **G. strictum** Aiton. New Haven, Gratiot Co.; Petoskey; Keweenaw Co., O. A. Farwell; St. Clair Co., A. F. Foreste.

1191. **G. vernum** (Raf.) T. & G. Spring Avens. St. Clair, Miss Gurd; Belle Isle, O. A. Farwell. Rare.

*1192. **G. Virginianum** L. Rough Avens. Common. C. & S.

SIEVERSIA R. Br. GEUM, in part.

1193. **S. ciliata** (Pursh.) Rydb. *Geum triflorum* Pursh. Otisco Tp., Ionia Co., A. B. Morse; Montcalm Co.; Ada, Greenville, C. A. Davis.

ULMARIA Hill.

1194. **U rubra** Hill. Queen-of-the-Prairie. *Spiraea lobata* Gronov. "Meadows and prairies, Penn. Co., Mich.," A. Gray. Occurs only in the S. W: R. R. track, near Augusta, L. H. Bailey; Calhoun Co.; University Herb. St. Joseph, V. Willoughby. S.

AGRIMONIA L.

*1195. **A. hirsuta** (Muhl.) Bicknell. Tall Hairy Agrimony. *A. Eupatoria hirsuta* Muhl. Dry soil. Common. Th.

*1196. **A. mollis** (T. & G.) Britton. Soft Agrimony. *A. Eupatoria mollis* T. & G. St. Clair Co., J. W. Stacey; Belle Isle, O. A. Farwell. Frequent.

1197. **A. parviflora** Soland. Many-flowered Agrimony. Detroit, Miss Clark; Macomb Co.; St. Clair Co., A. F. Foerste; S. W., H. S. Pepoon. Infrequent. S. E.

1198. **A. pumila** Muhl. Belle Isle, O. A. Farwell.

1199. **A. striata** Michx. Belle Isle, O. A. Farwell. *A. glabra* (Muhl.) Bicknell.

SANGUISORBA L. POTERIUM L.

1200. **S. Canadensis** L. American Great Burnet. *Boterium Canadense* A. Gray. South Haven, L. H. Bailey; Ann Arbor, Allmendinger. Rare.

ROSA L. Rose.

1201. **R. Arkansana** Porter. Harbor Springs, C. F. Wheeler; Keweenaw Co., O. A. Farwell. Rare.

1202. **R. blanda** Aiton. Ionia; Hubbardston; Flint; Ft. Gratiot, Winch. Cat.; Alma, Ann Arbor, C. A. Davis; Lake shore, New Buffalo, C. F. Wheeler, northward to

Keweenaw Co., O. A. Farwell. Common northward, but infrequent south of lat. 43° except along the shore of Lake Michigan. Th.

1203. **R. canina** L. Mackinac Island, Ypsilanti, O. A. Farwell.

*1205. **R. Carolina** L. Swamps. Common. Th.

*1206. **R. Carolina x humilis** C. F. Wheeler. A supposed hybrid. Border of a swamp near the Agricultural College.

1207. **R. centifolia** L. Along railway track St. Clair Co., C. K. Dodge.

1208. **R. Engelmanni** S. Wats. Prickly Rose. Cheboygan Co.; Mackinaw City; Petoskey, C. F. Wheeler; Keweenaw Co., O. A. Farwell.

*1209. **R. humilis** Marsh. Abundant and pretty. In the C. it is our common wild rose. Dry soil. Alma, Ann Arbor, C. A. Davis. A low form on hills about Ionia, has narrow leaves, with peduncles and ripe fruit glandular-bristly.

*1210. **R. rubiginosa** L. Sweetbrier. Eglantine. Roadsides. Frequent. C. & S.

1211. **R. Sayi** Schwein. Indian River, Black Lake, Cheboygan Co.; Mackinaw City; Petoskey, C. F. Wheeler; Oscoda; Keweenaw Co., O. A. Farwell. N. & U. P.

1212. **R. setigera** Michx. Climbing or Prairie Rose. South Haven, L. H. Bailey; Jackson Co., Winchell; Flint, Dr. Clark; Macomb Co., Cooley; Grosse Isle, Miss Clark; Belle Isle Park, Foerste; near Adrian, Mrs. I. H. Wheeler; along Bean Creek, Addison to Morenci, W. J. B. Indigenous, but rare or local. C. & S.

1213. **R. Woodsii** Lindl., Keweenaw Co., O. A. Farwell.

POMACEÆ L. Apple Family.

SORBUS L.

1214. **S. Aucuparia** L. European Mountain Ash. In a swamp near Bay City, G. M. Bradford.

1215. **S. Americana** Marsh. American Mountain Ash. *Pyrus Americana* DC. Ludington, and north along the Michigan shore to Charlevoix; Sault Ste. Marie; and into Canada where it is common; also westward, through U. P. Burt and Witney; near St. Clair River, C. K. Dodge. N. & U. P.

1216. **S. sambucifolia** (C. & S.) Roem. Western Mountain Ash. *Pyrus sambucifolia* Cham. & Schlect. Mackinac Island, H. Mann; Keweenaw Co., O. A. Farwell; near Houghton Lake, C. A. Davis.

PYRUS L.

1217. **P. communis** L. Common Pear. Ypsilanti, Detroit as an escape. O. A. Farwell.

MALUS Hill. PYRUS, in part.

*1218. **M. coronaria** (L.) Mill. American Crab Apple. *Pyrus coronaria* L. Thickets and along streams. Common. C. & S.

*1219. **M. Malus** (L.) Britton. Apple. Escaped from cultivation. Th.

ARONIA Medic. PYRUS, in part.

1220. **A. arbutifolia** (L.) Medic. Red Choke-berry. *Pyrus arbutifolia* L. f. Hubbardston, New Buffalo, Wheeler; St. Clair Co., C. K. Dodge, and northward.

*1221. **A. nigra** (Willd.) Britton. Black Choke-berry. *Pyrus arbutifolia melanocarpa* Michx. Burt. MS.; Isle Royale, Whitney's Cat. Frequent in swamps. Th.

AMELANCHIER Medic.

1222. **A. alnifolia** Nutt. Presque Isle, Winchell; Keweenaw Co., O. A. Farwell. Rare. N. & U. P.

*1223. **A. Canadensis** (L.) Medic. Shad-bush. Service-berry. Common. Th.

*1224. **A. Botryapium** (L. f.) DC. Shad-bush. *A. Canadensis oblongifolia* T. & G. Ionia; Flint; S. Mich., Winchell Cat.; Alma, Ann Arbor, C. A. Davis. Infrequent. Th.

1225. **A. oligocarpa** (Michx.) Roem. Shores of Lake Superior, Gray's Man.; Keweenaw Co., O. A. Farwell. U. P.

1226. **A. rotundifolia** (Michx.) Roem. Round-leaved June-berry. Grand River Valley, C. F. W.; Elk Rapids, W. S. Cooper. Not common.

1227. **A. spicata** (Lam.) Dec. Low June Berry. Shore of Thunder Bay, near Alpena, Grayling, C. F. Wheeler; Keweenaw Co., O. A. Farwell.

CRATAEGUS L.

1228. **C. acutiloba** Sargent. Detroit, O. A. Farwell.
1229. **C. albicans** Ashe. Detroit, O. A. Farwell.
1230. **C. altrix** Ashe. Detroit, O. A. Farwell.
1231. **C. ater** Ashe. St. Clair Co., W. W. Ashe.
1232. **C. attenuata** Ashe. St. Clair Co., W. W. Ashe
1233. **C. borealis** Ashe. St. Clair Co., W. W. Ashe; Keweenaw Co., O. A. Farwell.
1234. **C. brevispina** (Dougl.) Farwell. Keweenaw Co., O. A. Farwell. *C. punctata brevispina* Dougl.
1235. **C. caesa** Ashe. St. Clair Co., W. W. Ashe.
*1236. **C. coccinea** L. Common. Th.
*1237. **C. Crus-galli** L. Common. Th.
1238. **C. decans** Ashe. Detroit, O. A. Farwell.
1239. **C. Dodgei** Ashe. St. Clair Co., W. W. Ashe.
1240. **C. fallax** Ashe. St. Clair Co., W. W. Ashe.
1241. **C. filipes** Ashe. St. Clair Co., W. W. Ashe.
1242. **C. gemmosa** Sargent. Grand Rapids, Emma J. Cole; St. Clair Co., C. K. Dodge; Detroit, O. A. Farwell.
1243. **C. glareola** Ashe. St. Clair Co., W. W. Ashe.
1244. **C. immanis** Ashe. St. Clair Co., W. W. Ashe.
1245. **C. latisepala** Ashe. St. Clair Co., W. W. Ashe.
1246. **C. lanta** Ashe. St. Clair Co., W. W. Ashe.
1247. **C. lumaria** Ashe. St. Clair Co., W. W. Ashe.
*1248. **C. macrantha** Lodd. Long-spined Thorn. *C. coccinea macrantha* Dudley. Common. Th.
1249. **C. Michiganensis** Ashe. St. Clair Co., W. W. Ashe.
*1250. **C. mollis** (T. & G.) Scheele. Red-fruited Thorn. *C. coccinea mollis* T. & G. Frequent in C.: Monroe Co., C. F. Wheeler; Ontonagon, Mary H. Clark; Alma, Ann Arbor, C. A. Davis.
1251. **C. nuperia** Ashe. Detroit, O. A. Farwell.
1252. **C. obtecta** Ashe. St. Clair Co., W. W. Ashe.
1253. **C. onusta** Ashe. St. Clair Co., W. W. Ashe.
1254. **C. Oxyacantha** L. English Hawthorn. Detroit, O. A. Farwell.
1255. **C. pascens** Ashe. St. Clair Co., W. W. Ashe.
1256. **C. pastora** Sargent. Detroit, O. A. Farwell.
1257. **C. prona** Ashe. St. Clair Co., W. W. Ashe.
1258. **C. prunifolia** (Marsh.) Pers. Detroit, O. A. Farwell.
1259. **C. pubifolia** Ashe. St. Clair Co., W. W. Ashe.
1260. **C. pubipes** Ashe. St. Clair Co., W. W. Ashe.
*1261. **C. punctata** Jacq. Very variable. Common in south.
1262. **C. rotundifolia** (Ehrh.) Borck. Glandular Thorn. Grand Rapids, Island Lake, Grass Lake, C. F. Wheeler.
1263. **C. redolans** Ashe. Detroit, O. A. Farwell.
1264. **C. sera** Sargent. Detroit, O. A. Farwell.
1265. **C. structilis** Ashe. Detroit, O. A. Farwell.
1266. **C. tenax** Ashe. St. Clair Co., W. W. Ashe.
*1268. **C. tomentosa** L. Pear Thorn. Common. Th.
1269. **C. virella** Ashe. St. Clair Co., W. W. Ashe.

DRUPACEÆ DC. Plum Family.

PRUNUS L.

*1270. **P. Americana** Marsh. Wild Yellow or Red Plum. Black River, Cheboygan Co., B. & K.; St. Clair Co., C. K. Dodge; Detroit, O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Th.
*1271. **P. Cerasus** L. Sour Cherry. Escaped from cultivation by the aid of birds. Keweenaw Co., O. A. Farwell, and in many other places.
1272. **P. cuneata** Raf. Appalachian Cherry. Bay City and vicinity, G. M. Bradford; Keweenaw Co., O. A. Farwell.
1273. **P. domestica** L. Well established. St. Clair Co., C. K. Dodge; Ypsilanti, O. A. Farwell.
1274. **P. Mahaleb** L. Mahaleb Cherry. Well established near St. Clair, C. K. Dodge; Detroit, O. A. Farwell.

*1275. **P. nigra** Ait. Canada Plum. Port Huron northward; Detroit, O. A. Farwell.

*1276. **P. Pennsylvanica** L. f. Wild Red Cherry. Very abundant on sandy land in the N. half of the State, but less common southward, where P. serotina takes it place.

1277. **P. pumila** L. Dwarf Cherry. Sand Cherry. L. Sup.; Emmet Co.; Houghton Lake; Mecosta Co.; South Haven; Saginaw Bay, Winchell, etc.; St. Clair Co., C. K. Dodge. Frequent in the N. half of the L. P., but not yet found in the interior. S. of Saranac, Ionia Co., where it occurs in a dry glade.

*1278. **P. serotina** Ehrh. Wild Black Cherry. Frequent in C. and S. Rare in N. and U. P.

*1279. **P. Virginiana** L. Choke Cherry. A shrub or small tree. Common. Th.

AMYGDALUS L.

1279a. **A. Persica** L. Peach. Well established at Ypsilanti, O. A. Farwell.

CAESALPINACEÆ Kl. & Garcke. Senna Family.

CERCIS L.

*1280. **C. Canadensis** L. Red-bud. Judas-tree. Indigenous throughout the southern part of the State, and as far N. in the west as Grand River Valley. Plaster Creek, Grand Rapids, Garfield; Ionia, Le Valley; banks of Thornapple River. Eaton Co.; Ann Arbor; Adrian; South Haven; near Medina a tree was found 26 inches in diameter! W. J. B.

CASSIA L.

*1281. **C. Marilandica** L. Wild Senna. Grand Haven; Ann Arbor, river banks; Bay Co., G. M. Bradford. Infrequent. C. & S.

1282. **C. nictitans** L. Sturgis, F. P. Daniels; S. W., H. S. Pepoon.

GLEDITSIA L.

1283. **G. triacanthos** L. Three-thorned Acacia. Honey-Locust. Grows along the River Raisin, and is certainly indigenous. Often two feet in diameter, W. J. B. Along the St. Joseph, also, and in other localities in the extreme S. Dundee, Niles, C. F. Wheeler; Detroit, O. A. Farwell; Milan, C. A. Davis.

GYMNOCLADUS Lam.

1284. **G. dioica** (L.) Koch. Kentucky Coffee-tree. C. & S. *G. Canadensis* Lam. A slender tree along the river banks as far N. as Maple River, in Clinton Co.; also Fish Creek, Montcalm Co.; banks of Grand River; Macomb Co., W. J. B.; Belle Isle, O. A. Farwell and W. J. B.; Sturgis, F. P. Daniels; Ann Arbor, C. A. Davis. Infrequent.

PAPILIONACEÆ L. Pea Family.

BAPTISIA Vent.

1285. **B. leucantha** T. & G. Large White Wild Indigo. Calhoun Co., Winch. Cat.; Ann Arbor, Allmendinger Cat.; shore of Lake Erie, Goldie, Canadian Cat.; near Detroit, O. A. Farwell. Rare.

*1286. **B. tinctoria** (L.) R. Br. Wild Indigo. Woodward Lake, Ionia Co.; Flint; Macomb Co.; Ann Arbor, Winch. Cat.; Alma, C. A. Davis. Abundant in places but not well distributed. C. & S.

CROTALARIA L.

1287. **C. sagittalis** L. Rattle-box. Detroit, O. A. Farwell.

LUPINUS L.

*1288. **L. perennis** L. Wild Lupine. C. & S. Abundant in light sand.

1289. **L. perennis occidentalis** S. Wats. Benton Harbor, C. F. Wheeler.

1290. **L. polycarpus** Greene. Ballast grounds. Detroit, O. A. Farwell.

MEDICAGO L.

1291. **M. denticulata** Willd. Toothed Medick. Detroit, O. A. Farwell.
*1292. **M. lupulina** L. Black Medick. Nonesuch. Waste places. Mackinac; Jackson; Ann Arbor; Alma, C. A. Davis. L. P.
*1293. **M. sativa** L. Lucerne. Alfalfa. Escaped from cultivation in a few places.

MELILOTUS Juss.

*1294. **M. alba** Desv. White Melilot. Very common in the older portions of the State where it has often been sown by the roadside to furnish "pasture" for bees. L. P.
*1295. **M. officinalis** (L.) Lam. Yellow Melilot. It needs heavy soil. Rare. C. & S.

TRIFOLIUM L.

*1296. **T. arvense** L. Rabbit-foot or Stone Clover. Becoming naturalized in light soil.
1297. **T. aureum** Poll. Yellow or Hop Clover. *T. agrarium* L., in part. Port Huron, C. K. Dodge; Keweenaw Co., O. A. Farwell. Not common. Th.
1298. **T. depauperatum** Desv. Introduced at Detroit, O. A. Farwell.
1299. **T. dubium** Sibth. Grand Rapids, Miss E. J. Cole; Detroit and Ypsilanti, O. A. Farwell.
1300. **T. furcatum** Lindl. Introduced at Detroit, O A Farwell
*1301. **T. hybridum** L. Alsike Clover. Escaped from cultivation.
1302. **T. medium** L. Occasional in roads and fields. Port Huron, C. K. Dodge.
*1303. **T. pratense** L. Red Clover. Meadows and fields. Th.
*1304. **T. procumbens** L. Low Hop-Clover. Infrequent. C. & S.
*1305. **T. repens** L. White Clover. Meadows, pastures and roadsides. Very common. Th.
1306. **T. stoloniferum** Muhl. Running Buffalo Clover. Kalamazoo, Tuthill. Introduced (?)

AMORPHA L.

1307. **A. canescens** Pursh. Lead-plant. W. Mich., Winch. Cat.; Ann Arbor, Prof. M. W. Harrington; Kalamazoo: Tuthill; Klinger Lake; Barron Lake, C. F. Wheeler; Sturgis, F P. Daniels; Berrien Co., H. S. Pepoon. Rare.

KUHNISTERA Lam. PETALOSTEMON Michx.

1308. **K. purpurea** (Vent.) MacM. Violet Prairie-clover. *Petalostemon violaceus* Michx. Berrien Co., H. S. Pepoon.

CRACCA L. TEPHROSIA Pers.

1309. **C. Virginiana** L. Goat's Rue. Catgut. *Tephrosia Virginiana* Pers. Clinton Co.; Montcalm Co.; Newaygo Co.; Macomb Co.; Livingston Co., Miss Clark. On light sand. Infrequent. C. & S.

ROBINIA L.

*1310. **R. Pseudacacia** L. Common Locust or False Acacia. Escaped from cultivation.
1311. **R. viscosa** Vent. Clammy Locust. Escaped from cultivation at Ionia, C. F. Wheeler.

ASTRAGALUS L.

*1312. **A. Carolinianus** L. Carolina Milk Vetch. *A. Canadensis* L. Put-in-Bay; Ann Arbor; Macomb Co.; Orchard Lake; Montcalm Co.; river bank, North Lansing; Shiawassee Co., G. H. Hicks; Whitmore Lake, C. A. Davis; and northward. Well distributed, but infrequent. Th.

PHACA L. Some authors.

*1313. **P. neglecta** T. & G. Cooper's Milk Vetch. *Astragalus Cooperi* A. Gray. Dr. A. B. Lyons; Cooley MS.; Park Lake, Clinton Co., L. H. Bailey; Alma. Rare. C. & S.

STROPHOSTYLES Ell.

1314. **S. helvola** (L.) Britton. Trailing Wild Bean. *S. angulosa* Ell. S. E. along shore, and on the islands of Lake Erie, and shore of Lake Michigan at South Haven, L. H. Bailey; Belle Isle, O. A. Farwell. Probably not much farther north, and not found in the interior.

MEIBOMIA Heist. DESMODIUM Desv.

*1315. **M. bracteosa** (Michx.) Kuntze. Large-bracted Tick-trefoil. *Desmodium cuspidatum* Hook. Hubbardston; Flint; Ann Arbor; Macomb Co.; S. Mich., Wright; Alma. Usually on oak land. Frequent. C. & S.

*1316. **M. Canadensis** (L.) Kuntze. Showy Tick-trefoil. *Desmodium Canadense* DC. Hubbardston, and probably father N.; Flint; Ann Arbor, Allmendinger Cat. and Winch. Cat. Flowers early. Frequent. Th.

1317. **M. canescens** (L.) Kuntze. Hoary Tick-trefoil. *Desmodium canescens* DC. Ann Arbor, Allmend. Cat.; S. West, Wright. Cat. Rare. S.

*1318. **M. Dillenii** (Darl.) Kuntze. Dillen's Tick-trefoil. *Desmodium Dillenii* Darlington. Oak woods. Hubbardston; Flint; Macomb Co.; S. Mich., Wright Cat.; Mont Lake, Miss Clark. Frequent. C. & S.

*1319. **M. grandiflora** (Walt.) Kuntze. Pointed-leaved Tick-trefoil. *Desmodium acuminatum* DC. Woodlands. Very common. C. & S.

1320. **M. Illinoensis** (A. Gray) Kuntze. Illinois Tick-trefoil. *Desmodium Illinoense* A. Gray. University campus, Ann Arbor; White Pigeon, W. J. B.; S. W., H. S. Pepoon.

*1321. **M. Marilandica** (L.) Kuntze. Small-leaved Tick-trefoil. *Desmodium Marilandicum* F. Boott. Dry hills; Ionia, and southward; near Park Lake, Clinton Co., W. J. B.; Orion, O. A. Farwell. Infrequent. C. & S.

*1322. **M. Michauxii** Vail. Prostrate Tick-trefoil. *Desmodium rotundifolium* DC. Hubbardston; Ionia; Flint; South Haven; Macomb Co.; Ann Arbor, Allmend. Cat.; Orion, O. A. Farwell. Infrequent. C. & S.

*1323. **M. nudiflora** (L.) Kuntze. Naked-flowered Tick-trefoil. *Desmodium nudiflorum* DC. Crystal Lake, Montcalm Co.; Flint; Macomb Co.; S. Mich., Wright. Cat. Common. C. & S.

1324. **M. obtusa** (Muhl.) Vail. Hairy Small-leaved Tick-trefoil. *Desmodium ciliare* DC. Dr. Wright. Rare. S.

*1325. **M. paniculata** (L.) Kuntze. Panicled Tick-trefoil. *Desmodium paniculatum* DC. Oak woods. Hubbardston; Flint; Macomb Co.; Alma; South Haven; S. Mich., Wright's Cat. Frequent. C. & S.

*1326. **M pauciflora** (Nutt.) Kuntze. Few-flowered Tick-trefoil. *Desmodium pauciflorum* DC. Mont Lake, Miss Clark in Winch. Cat. Rare. S.

1327. **M. rigida** Ell. Kuntze. Rigid Tick-trefoil. *Desmodium rigidum* DC. Hubbardston; Flint; Macomb Co.; Ann Arbor and S. W., Winch. Cat. Infrequent. C. & S.

1328. **M. sessilifolia** (Torr.) Kuntze. Sessile-leaved Tick-trefoil. *Desmodium sessilifolium* T. & G. Michigan, A. Gray; S. Mich., Winch. Cat.; University Herb., Niles, Ames; Greenville; Rochester, O. A. Farwell. Rare. S.

LESPEDEZA Michx.

1329. **L. augustifolia** (Pursh.) Ell. Narrow-leaved Bush-clover. Sandy fields. Infrequent. C. & S.

*1330. **L. capitata** Michx. Round-headed Bush-clover. Abundant in old fields; prefers light sand. Common. C. & S.

*1331. **L. frutescens** (L.) Britton. Wand-like Bush-clover. *L. Stuvei intermedia* S. Watts. *L. reticulata* S. Wats. Gray's Manual; Britton and Brown; Orion and Detroit, O. A. Farwell; S. W., H. S. Pepoon. S.

*1332. **L. hirta** (L.) Ell. Hairy Bush-clover. *L. polystachya* Michx. Common. C. & S.

1333. **L. Nuttallii** Darl. Nuttall's Bush-clover. Britton and Brown.

1334. **L. procumbens** Michx. Trailing Bush-clover. S. W., H. S. Pepoon.

1335. **L. Stuvei** Nutt. Stuve's Bush-clover. Winchell Cat.; Gray in Manual. Rare. S.

*1336. **L. violacea** (L.) Pers. Bush-clover. Ann Arbor, Miss Clark; S. W., Wright; Rochester, O. A. Farwell; Vestaburg, C. A. Davis. Infrequent.

1337. **L. Virginica** (L.) Britton. Slender Bush-clover Munith, G. H. Hicks; Norvell, C. F. Wheeler; Orion, O. A. Farwell.

VICIA L.

*1338. **V. Americana** Muhl. Ann Arbor; Ionia; Montcalm Co.; N. to Lake Superior; Whitmore Lake, C. A. Davis. Spreads rapidly in C., along railroads and highways and acts like an immigrant. Th.

1339. **V. angustifolia** Roth. Smaller Vetch. *V. sativa angustifolia* Ser. Keweenaw Co., O. A. Farwell.

*1340. **V Caroliniana** Walter. Dry soil. Common. C. & S.

1341. **V. Cracca** L. Cow Vetch. S. Mich., Wright Cat.; Ann Arbor, Prof. M. W. Harrington; Alma, C. A. Davis. Rare or local.

1342. **V. sativa** L. Common Vetch. Tare. Detroit, Dr. Lyons; Springwells, Henry Gillman; Port Huron, C. K. Dodge; Belle Isle, O. A. Farwell; Alma. Infrequent.

LATHYRUS L.

1343. **L. maritimus** (L.) Bigel. Beach Pea. All around the Great Lakes, but seldom seen in the interior. Shore of Higgins Lake, G. H. Cannon. Th.

1344. **L. myrtifolius** Muhl. Myrtle-leaved Marsh Pea. *L. palustris myrtifolius* A. Gray. Infrequent. Th.

*1345. **L. ochroleucus** Hooker. Hillsides and dry uplands. Keweenaw Co., O. A. Farwell; Alma, and southward. Infrequent. Th.

*1346. **L. palustris** L. Ann Arbor; Ionia; Bay City, Antrim Co.; Alma; Petoskey to L. Sup. Th.

1347. **L. venosus** Muhl. Ionia Co.; Clinton Co.; Flint; Macomb Co.; Ann Arbor; Vestaburg. Northward to Keweenaw Co., O. A. Farwell. Infrequent. Th.

FALCATA Gmel. AMPHICARPAEA Ell.

*1348. **F. comosa** (L.) Kuntze. Hog Pea-nut. *Amphicarpaea monoica* Ell. Fields and woods. Common. Th.

*1349. **F. Pitcheri** (T. & G.) Kuntze. Pitcher's Hog Pea-nut. *Amphicarpaea Pitcheri* T. & G. Moist woodlands. Hubbardston, C. F. Wheeler; Lenawee Co., W. J. B.; Manistee, F. P. Daniels; Alma, Whitmore Lake, C. A. Davis.

APIOS Moench.

*1350. **Apios Apios** (L.) MacM. Ground-nut. *A. tuberosa* Moench. Common. C. & S.

GERANIACEÆ J. St. Hil. Geranium Family.

GERANIUM L.

1351. **G. Bicknellii** Britton. Bicknell's Crane's-bill. Thunder Bay Island, Alpena Co., C. F. Wheeler; Keweenaw Co., O. A. Farwell.

*1352. **G. Carolinianum** L. Carolina Crane's-bill. Macomb Co.; Clinton Co.; Alma. Rare in S. & C., abundant in vicinity of Farwell, Clare Co., thence N. to L. Superior. Th.

1353. **G. columbinum** L. Long-stalked Crane's-bill. Grand Detour, T. C. Porter.

*1354. **G. maculatum** L. Wild Crane's-bill. Canada to Florida. T. & G. Common. C. & S.

1355. **G. molle** L. Harbor Springs, Hon. G. L. Maurice.

*1356. **G. pusillum** Burm. f. Small-flowered Crane's-bill. Flint, Dr. Clark; Benzie Co., W. J. B.; Constantine, C. F. Wheeler; St. Clair Co., C. K. Dodge; Ann Arbor, C. A. Davis. Adventive.

1357. **G. Robertianum** L. Herb Robert. Put-in-Bay, Lake Erie; Montcalm Co.; Saginaw Bay; Mackinac, and Drummond's Is., Winch. Cat.; L. Sup. Whitney's Cat.; Keweenaw Co., O. A. Farwell; Island near Algonac, C. K. Dodge. Common around the Great Lakes, but seldom seen in the interior.

1358. **G rotundifolium** L. Round-leaved Crane's-bill. Britton & Brown.

ERODIUM L'Her.

1359. **E. cicutarium** (L.) L'Her. Stork's-bill. Alfilarilla. Oceana Co.; Ionia Co.; Kalamazoo; Port Huron, C. K. Dodge. Not yet common.

OXALIDACEÆ Lindl. Wood-Sorrel Family.

OXALIS L.

1360. **O. Acetosella** L. Common Wood-sorrel. Macomb Co.; L. Sup. and northward, A. Gray. Rare in S. Peninsula. Th.
1361. **O. corniculata** L. Rochester, O. A. Farwell.
1362. **O. cymosa** Small. Tall Yellow Wood-sorrel. Marquette Co., Burt's MS., Rochester, O. A. Farwell. Southward. Common.
*1363. **O. stricta** L. Upright Yellow Wood-sorrel. Marquette southward. Common.
1364. **O. violacea** L. Violet Wood-sorrel. Winchell Cat.; S. W., H. S. Pepoon. Rare. S. E.

LINACEÆ Dumort. Flax Family.

LINUM L.

1365. **L. humule** Mill. Belle Isle, rare. O. A. Farwell.
1366. **L. medium** (Planch.) Britton. Port Huron, C. K. Dodge; Belle Isle, O. A. Farwell.
1367. **L. striatum** Walt. Ridged Yellow Flax. S. W., H. S. Pepoon.
1368. **L. sulcatum** Riddell. Grooved Yellow Flax. Dr. Wright; University Herb. Rare. S.
1369. **L. usitatissimum** L. Common Flax. Dr. Clark, and Dr. Wright; Keweenaw Co., O. A. Farwell; Alma, C. A. Davis. Escaped from cultivation. Infrequent.
*1370. **L. Virginianum** L. Wild Yellow Flax. Ann Arbor, Dr. Lyons; S. Mich., Wright Cat.; Lenawee Co., G. F. Comstock. Infrequent. S.

RUTACEÆ Juss. Rue Family.

XANTHOXYLUM L.

*1371. **X. Americanum** Mill. Northern Prickly Ash. Toothache-tree. Everywhere along streams and on low ground. L. P.

PTELEA L.

*1372. **P. trifoliata** L. Hop-tree Shrubby Trefoil. Very abundant on the low, rocky islands in the western end of Lake Erie, and frequent along river banks and the shore of the Great Lakes. Occurs in the interior as far north as Montcalm Co. Does not occur at Flint, and is not mentioned in Dr. Cooley's MS. Cat., but is given in Dr. Wright. Alma, Ann Arbor, C. A. Davis. C. & S.

SIMARUBACEÆ DC. Ailanthus Family.

AILANTHUS Desf.

1373. **A. glandulosa** Desf. Tree-of-Heaven. Port Huron, C. K. Dodge; Detroit, O. A. Farwell.

POLYGALACEÆ Reichenb. Milkwort Family.

POLYGALA L.

1374. **P. ambigua** Nutt. Loose-spiked Milkwort. *P. verticillata ambigua* Wood. Ypsilanti, Mrs. Lucy Osband; Port Huron, C. K. Dodge.
1375. **P. cruciata** L. S. Mich., Wright Cat. Rare. S.
1376. **P. incarnata** L. Pink Milkwort. Port Huron, Walpole Island, C. K. Dodge. Rare.
*1377. **P. paucifolia** Willd. Flowering Wintergreen. Fringed Polygala. Common on pine land. Th.

*1378. **P. polygama** Walt. Sandy soil. Ionia, Clinton and Montcalm Counties; Grass Lake, Vestaburg, C. A. Davis. Southward. Abundant near Quinnesec, Menominee Co., E. J. Hill. Th.

*1379. **P. Senega** L. Seneca Snakeroot. Alma, C. A. Davis; Bay Co., G. M. Bradford; near Detroit, O. A. Farwell. Th.

1380. **P. Senega latifolia** Torr. & Gray. Hubbardston; Flint; Ann Arbor, C. A. Davis. Rare. Th.

*1381. **P. verticillata** L. Whorled Milkwort. Flint; Macomb Co.; Wayne Co. Common in some places, rare in others.

*1382. **P. viridescens** L. Purple Milkwort. *P. sanguinea* L. Belding; Ionia; Flint; Macomb Co.; Grass Lake, Whitmore Lake, C. A. Davis. Local, but usually abundant when found at all. C. & S.

EUPHORBIACEÆ J. St. Hil. Spurge Family.

ACALYPHA L.

1383. **A. gracilens** A. Gray. Slender Three-seeded Mercury. *A. Virginica gracilens* Muell. Detroit, Dr. D. Clark.

*1384. **A. Virginica** L. Three-seeded Mercury. Open woods. Variable. Common. Th.

EUPHORBIA L.

1385. **E. commutata** Engelm. Tinted Spurge. Ann Arbor, C. A. Davis; Flint. Infrequent.

*1386. **E. corollata** L. Flowering Spurge. Sandy soil. Frequent. C. & S.

*1387. **E. Cyparissias** L. Cypress Spurge. Escaped from cultivation. Frequent.

*1388. **E. Esula** L. Leafy Spurge. Escaped from cultivation.

1389. **E. glyptosperma** Engelm. Ridge-seeded Spurge. Escanaba, Marquette, C. F. Wheeler.

1390. **E. Helioscopia** L. Sun Spurge. Common at Detroit, Dr. A. B. Lyons; St. Clair Co., C. K. Dodge; Mackinac Island, O. A. Farwell.

1391. **E. hirsuta** (Torr.) Weigand. Hairy Spurge. *E. hypericifolia hirsuta* Torr. Clair Co., C. K. Dodge; Mackinac Island, O. A. Farwell.

1392. **E. humistrata** Engelm. Hairy Spreading Spurge. Flint, Dr. D. Clark; St. Clair Co., C. K. Dodge; Bay Co., G. M. Bradford.

*1393. **E. maculata** L. Spotted Spurge. Roadsides and fields, everywhere.

1394. **E. Nicaeensis** All. Nicaean Spurge. Port Huron, C. K. Dodge

*1395. **E. nutans** Lag. Upright Spotted Spurge. *E. Preslii* Guss. Cultivated soil, and waste places. Detroit, Dr. A. B. Lyons; Ionia; Grand Rapids. Infrequent. C. & S.

*1396. **E. obtusata** Pursh. Belle Isle, rare, O. A. Farwell.

*1397. **E. Peplus** L. Petty Spurge. Grand Rapids, H. C. Skeels; Olivet, H. L. Clark.

1398. **E. platyphylla** L. Broad-leaved Spurge. Macomb Co.; "along the Great Lakes," A. Gray; Lake Huron, Dr. Todd.

1399. **E. polygonifolia** L. Knotweed Spurge. Sandy shores of the Great Lakes. South Haven, L. H. Bailey; Fort Gratiot, Winch. Cat.; Roscommon and Ann Arbor, C. A. Davis. Frequent. Th.

1400. **E. serpyllifolia** Pers. Thyme-leaved Spurge. Keweenaw Co., O. A. Farwell.

CALLITRICHACEÆ Lindl. Water-Starwort Family.

CALLITRICHE L.

1401. **C. bifida** (L.) Morong. Northern Water Starwort. *C. autumnalis* L. Flint, Dr. Clark; L. Superior, A. Gray; Alma, C. A. Davis; Sault de Ste. Marie, T. Morong.

1402. **C. palustris** L. Water Starwort. Water Fennel. *C. verna* L. Ponds, Macomb Co., Cooley; Keweenaw Co., O. A. Farwell; Norway, E. J. Hill; Alma, C. A. Davis.

EMPETRACEÆ Dumort. Crowberry Family.

EMPETRUM L.

1403. **E. nigrum** L. Black Crowberry. Whitney Cat. Pictured Rocks, G. H. Hicks. U. P.

LIMMANTHACEÆ Lindl. False Mermaid Family.

FLOERKEA Willd.

*1404. **F. proserpinacoides** Willd. False Mermaid. Ionia; Hubbardston; Flint; Ann Arbor, C. A. Davis. Not rare but usually overlooked.

ANACARDIACEÆ Lindl. Sumac Family.

RHUS L.

1405. **R. aromatica** Ait. Fragrant Sumach. *R. Canadensis* Marsh. Less frequent than other members of the genus. Found chiefly on bluffs and sandy hills through the middle counties of the L. P. "N. to the Saskatchawan," Torr. & Gr.; Saginaw Co., Washtenaw Co., C. A. Davis. Th.

*1406. **R. copallina** L. Dwarf Sumach. Abundant in the pine country on light soil. C. & S.

*1407. **R. glabra** L. Smooth Sumach. Alma, Ann Arbor, C. A. Davis. Very common in C. Th.

1407a. **R. glabra borealis** Britton. Keweenaw Co., O. A. Farwell.

*1408. **R. hirta** (L.) Sudw. Staghorn Sumach. *R. typhina* L. Alma, Ann Arbor, C. A. Davis.

1409. **R. pubescens** (Mill) O. A. F. Northern Poison Oak. *R. Toxicodendron quercifolia* Michx. Belle Isle, O. A. Farwell.

*1410. **R. radicans** L. Poison, climbing or Three-leaved Ivy. Poison Oak. L. P.

1411. **R. Rydbergii** Small. Keweenaw Co., O. A. Farwell.

*1412. **R Toxicodendron** L. Tall-climbing, often to tops of forest trees; stems occasionally several inches in diameter. Th.

*1413. **R. Vernix** L. Poison Sumach. Poison Elder. *R. venenata* DC. Common in swamps. Green Lake, G. Traverse Co. and southward. L. P.

ILICACEÆ Lowe. Holly Family.

ILEX L.

*1414. **I. verticillata** (L.) A. Gray. Black Alder. Winterberry. Low grounds. Th.

ILICIOIDES Dumont. NEMOPANTHES Raf.

*1415. **I. mucronata** (L.) Britton. Mountain Holly. *Nemopanthes fascicularis* Raf. Borders of swamps. S. Mich., Wright Cat.; Ionia Co.; Alma, Ann Arbor, C. A. Davis; Montcalm Co.; Flint; Macomb Co., and northward. Frequent. Th.

CELASTRACEÆ Lindl. Staff-tree Family.

EUONYMUS L.

*1416. **E. atropurpureus** Jacq. Wahoo. Burning Bush. Low river banks. Well distributed, but nowhere very common. C. & S.

*1417. **E. obovatus** Nutt. Strawberry Bush. *E. Americanus obobatus* T. & G. Trailing. Common. C. & S.

CELASTRUS L.

*1418. **C. scandens** L. Wax-work. Climbing Bittersweet. Frequent. Th.

STAPHYLEACEÆ DC. Bladder-nut Family.

STAPHYLEA L.

*1419. **S. trifolia** L. American Bladder-nut. Marquette Co., and southward, Burt. Frequent along river banks in L. P. Th.

ACERACEÆ J. St. Hil. Maple Family.

ACER L.

*1420. **A. Negundo** L. Box Elder. Ash-leaved Maple. Th. *Negundo aceroides* Moench. River banks. A small tree. West of Lake Superior. and north to Saskatchewan Valley. Macoun in Candian Cat. Frequent in Grand River Valley; escaped from cultivation in St. Clair Co., C. K. Dodge; Belle Isle, Alma. Ann Arbor, C. A. Davis. Th.

*1420a. **A. nigrum** Michx. Black Sugar Maple. *A. saccharinum nigrum* T. & G. Common. C. & S.

1421. **A. Pennsylvanicum** L. Striped Maple. Abundant in U. P. Whitney; common at Petoskey, and occasional as far S. on the Huron shore as Alcona Co., Winchell Cat.; in the interior as far as Houghton Lake. N. & U. P.

1422. **A. platanoides** L. Norway Maple. Banks of Huron River, Ypsilanti, O. A. Farwell. Introduced from Europe.

*1424. **A. rubrum** L. Red or Swamp Maple. On low ground and along streams. Very common. Th.

*1425. **A. saccharinum** L. Silver Maple. *A. dasycarpum* Ehrh. Low ground along rivers. Common. C. & S.

*1426. **A. Saccharum** Marsh. Rock or Sugar Maple. *A. saccharinum* Wang. Frequent in the U. P., and abundant in the lower, forming extensive groves, either alone or in connection with beech. Th.

*1427. **A. spictatum** Lam. Mountain Maple. Common in U. P.; Alcona Co., Winch. Cat.; Crystal Lake, Montcalm Co.; Alma. C. N. & U. P.

HIPPOCASTANACEÆ T. & G. Buckeye Family.

ÆSCULUS L.

1428. **AE. glabra** Willd. Ohio Buckeye. Fetid B. Lenawee Co., W. J. B.; Washtenaw Co., O. A. Farwell, and probably in other localities in the southern tier of counties. S

1429. **AE. Hippocastenum** L. Horse-chestnut. Escaped from cultivation. St. Clair Co., C. K. Dodge; Washtenaw and Wayne counties, O. A. Farwell.

BALSAMINACEÆ Lindl. Jewel-weed Family.

IMPATIENS L.

*1430. **I. aurea** Muhl. Pale Touch-me-not. *I. pallida* Nutt. Macomb Co.; Ionia Co.; Sugar Is., Winch. Cat.; Ann Arbor, C. A. Davis. Much rarer than the next. Th.

*1431. **I. biflora** Walt. Spotted Touch-me-not. *I. fulva* Nutt. Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Southward.

RHAMNACEÆ Dumort. Buckthorn Family.

RHAMNUS L.

*1432. **R. alnifolia** L'Her. Alma, Ann Arbor, C. A. Davis. Common. Th.

*1433. **R. cathartica** L. Buckthorn. Escaped from cultivation. Lansing, and very likely in other portions of the state.

CEANOTHUS L.

*1434. **C. Americanus** L. New Jersey Tea. Red-root. Sandy woods, rarely on beech and maple land. Alma, Ann Arbor, C. A. Davis. Frequent.

1435. **C. ovatus** Desf. Smaller Red-root. East shore L. Huron, E. Ont. and L. Sup., Can. Cat.; Cheboygan Co., B. & K.; Alcona Co.; Grayling; Oscoda; Manistee, F. P. Daniels.

VITACEÆ Lindl. Grape Family.

VITIS L.

1436. **V. aestivalis** Michx. Summer Grape. Sturgis, F. P. Daniels.

*1437. **V. bicolor** Le Conte. Winter Grape. Lyons; Stanton; Crystal Lake; Montcalm Co.; Flint; Ann Arbor, Winch. Cat.; Bay Co., G. M. Bradford; S. Mich., Wright Cat. Infrequent. C. & S.

1438. **V. cordifolia** Michx. Frost Grape. Sturgis, F. P. Daniels.

*1439. **V. Labrusca** L. Northern Fox-grape. Muskegon, W. J. B.

1440. **V. rotundifolia** Michx. Rochester, O. A. Farwell.

*1441. **V. vulpina** L. Riverside Grape. *riparia* Michx. Sturgis, F. P. Daniels. Common along our rivers; infrequent in the pine region, where V. bicolor is very abundant. Th.

PARTHENOCISSUS Planch.

*1442. **P. quinquefolia** (L.) Planch. Virginia Creeper. American Ivy. *Ampelopsis quinquefolia* Michx. Common. Th.

1443. **P. quinquefolia laciniata** (Planch.) *R. vitacea* A. S. Hitchcock. Frequent.

1444. **P. quinquefolia hirsuta** (Donn.) Torr. & Gray. Bald-head Park, Saugatuck, C. F. Wheeler; Belle Isle, O. A. Farwell.

TILIACEÆ Juss. Linden Family.

TILIA L.

*1445. **T. Americana** L. Basswood. Linden. Abundant in C. & S., common in Emmet Co., and frequent in U. P., "especially in Ontonagon Valley," Whitney Cat. Th.

MALVACEÆ Neck. Mallow Family.

ALTHAEA L.

1446. **A. officinalis** L. Marsh-Mallow. Bay Co., G. M. Bradford; Detroit, O. A. Farwell.

MALVA L.

*1447. **M. Alcea** L. European Mallow. Adventive at the Agricultural College; Manistee, F. P. Daniels.

*1447a. **M. crispa** L. Curled Mallow. *M. verticillata crispa* L. Flint, Dr. Clark; Detroit, O. A. Farwell.

*1448. **M. moschata** L. Musk Mallow. Keweenaw Co., O. A. Farwell; Alma, C. A. Davis. Southward. Not rare.

*1449. **M. rotundifolia** L. Common Mallow. Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Southward. Common. Th.

*1450. **M. sylvestris** L. High Mallow. Occasional. L. P.

SIDA L.

1452. **S. hermaphrodita** (L.) Rusby. Virginia Mallow. *S. Napaea* Cav. Kalamazoo, R. R. track, Tuthill. Rare. S.

1453. **S. spinosa** L. Prickly Sida. Britton and Brown.

ABUTILON Gaertn.

*1454. **A. Abutilon** (L.) Rusby. Velvet-leaf. *A. Avicennae* Gaert. Roadsides and river banks. Very common in places, and, along with Datura Stramonium, forming regular thickets. Alma, Ann Arbor, C. A. Davis. C. & S.

HIBISCUS L.

1455. **H. Moscheutos** L. Swamp Rose-mallow. Monroe; Flint; Put-in-Bay, Lake Erie; St. Joseph, V. Willoughby; Detroit, D. H. Campbell; Saugatuck, Tuthill. Rare. C. & S.

*1456. **H. Trionum** L. Bladder Ketmia. South, Dr. Wright; Ann Arbor, Winch. Cat.; Flint; Ypsilanti, O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Rare.

HYPERICACEÆ Lindl. St. John's-wort Family.

HYPERICUM L.

*1457. **H. Ascyron** L. Great St. John's Wort. South Haven; Ann Arbor; Ft. Gratiot; Macomb Co.; Ionia; Stanton; Hubbardston; Alma; Crystal Lake; Flint; Ontonagon River, Whitney Cat.; Grand Rapids, Sones; Keweenaw Co., O. A. Farwell. Occurs at wide intervals and in small patches. Th.

1458. **H. boreale** (Britton) Bicknell. *H. Canadense boreale* Britton. Keweenaw Co., O. A. Farwell.

*1459. **H. Canadense** L. Canadian St. John's-wort. Ann Arbor, Miss Clark; L. Sup., A. Gray; Keweenaw Co., O. A. Farwell; Carp River, Porter; Alma. Infrequent.

1460. **H. ellipticum** Hook. Ann Arbor, Miss Clark; Keweenaw Co., O. A. Farwell; Carp River, T. C. Porter. Infrequent.

1461. **H. Kalmianum** L. Kalm's St. John's-wort. Along the lakes; more common northward. Manistee, F. P. Daniels; Fort Gratiot, Winch. Cat.; Petoskey; Port Austin, C. A. Davis; S. W., H. S. Pepoon. Th.

*1462. **H. maculatum** Walt. Spotted St. John's-wort. Common. Th.

*1463. **H. majus** (A. Gray) Britton. Larger Canadian St. John's-wort. *H. Canadense majus* A. Gray. St. Clair Co., Foerste; Flint; Fruitport and Old Mission, E. J. Hill; L. Sup., A. Gray. Vestaburg. Th.

*1464. **H. mutilum** L. Dwarf St. John's-wort. Common. Th.

*1465. **H. perforatum** L. Common St. John's-wort. Ionia; Flint; Keweenaw Co., O. A. Farwell. Infrequent.

*1466. **H. prolificum** L. Shrubby St. J. A low, compact shrub. Frequent from C. Southward. Th.

SAROTHRA L.

1467. **S. gentianoides** L. Pine-weed. *Hypericum nudicaule* Walt. Ypsilanti. O. A. Farwell.

TRIADENUM Raf. ELODEA Pursh, not Michx.

*1468. **T. Virginicum** (L.) Raf. Marsh St. John's-wort. *Elodea campanulata* Pursh. Common. Th.

CISTACEÆ Lindl. Rock-rose Family.

HELIANTHEMUM Pers.

*1469. **H. Canadense** (L.) Michx. Frost-weed. Frequent. Th.

1470. **H. majus** (L.) B. S. P. Hoary Frost-weed. Vestaburg, Davis and Wheeler; Muskegon, W. J. B.; Fife Lake, Alpena, C. F. Wheeler; Detroit, O. A. Farwell.

HUDSONIA L.

1471. **H. tomentosa** Nutt. False Heather. Shores of Great Lakes, A. Gray; S. Mich., Winch. Cat.; L. Sup., Can. Cat.; Oscoda. Frequent. Th.

LECHEA L.

1472. **L. intermedia** Leggett. Large-podded Pin-weed. Port Huron, C. K. Dodge; Bay Co., G. M. Bradford.

1473. **L. minor** L. Thyme-leaved Pin-weed. Pointe aux Pins, Lake Superior, Dawson; Au Sable, W. J. B.; St. Clair Co., C. K. Dodge.

1474. **L. stricta** Leggett. Prairie Pin-weed. Lower falls of the Menominee River, C. F. Wheeler.

*1475. **L. villosa** Ell. Hairy Pin-weed. *L. major* Michx. Common on poor soil. C. & S.

VIOLACEÆ DC. Violet Family.

VIOLA L.

*1477. **V. arenaria** D C. Sand Violet. Sandy land. Crawford Co., W. J. B.

*1478. **V. blanda** Willd. Sweet White Violet. Low ground. Common and variable. Th.

*1479. **V. Canadensis** L. Canada Violet. Abundant on beech and maple land, but seldom, or never found under oaks. Th.

*1479a. **V. cuculata** Ait. Marsh Blue Violet. *V. affinis* Le Conte. *V. obliqua* Hill. Very common. Th.

1479a. **V. crassula** Greene. Near Jackson. E. L. Greene.

1480. **V. cuspidata** Greene. Utica in Macomb Co., W. S. Cooper.

1481. **V. emarginata** (Nutt.) Le Conte. Triangle-leaved Violet. Munith, G. H. Hicks; Muskegon, W. J. B.; Detroit, O. A. Farwell.

1482. **V. fimbriatula** J. E. Smith. *V. orata* Nutt. S. W., H. S. Pepoon. Very rare. Ann Arbor, Grand Rapids, C. F. Wheeler; Bay City, G. M. Bradford; Detroit, O. A. Farwell.

*1483. **V. Labradorica** Schrank. American Dog Violet. *V. canina Muhlenbergii* Traut. Common. Th.

1484. **V. lanceolata** L. Lance-leaved Violet. W. Harrisville, Glade Pt.; Kalkaska Co.; Roscommon Co.; L. Sup.; Belle Isle, O. A. Farwell; Vestaburg, C. A. Davis.

1484a. **V. Le Conteana** Don. *V. blanda amœna* (Le Conte) B. S. P. Towar's swamp, near Lansing; Cheboygan Co., B. & K.; shores of Barron Lake, Cass Co.; Keweenaw Co., O. A. Farwell.

1484a. **V. nodosa** Green. Marengo, Mich. E. L. Greene.

*1485. **V. palmata** L. Early Blue Violet. Dry to moist woods. Ann Arbor, C. A. Davis.

1485a. **V. papilionacea** Pk. Hooded Blue Violet. Very common.

*1486. **V. pedata** L. Bird-foot Violet. Common on light sand; our finest species N. to British Am.; lat. 55°. Torr. & Gr., Fl. N. Am. Th.

1486a. **V. peramoena** Greene. Marengo. E. L. Greene.

*1487. **V. pubescens** Aiton. Downy Yellow Violet. Beech woods. Common. Th.

*1488. **V. pubescens eriocarpa** (Schw.) Nutt. Detroit, O. A. Farwell.

*1489. **V. renifolia** A. Gray. Kidney-leaved Violet. *V. blanda renifolia* A. Gray. Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell, Gratiot Co., C. A. Davis.

*1490. **V. rostrata** Pursh. Long-spurred Violet. Well distributed and frequent. Alma, Ann Arbor, C. A. Davis. C. & S.

1491. **V. rotundifolia** Michx. Round-leaved Violet. Sugar Island, Winch. Cat.; Michigan, A. Gray. U. P.

1492. **V. sagittata** Aiton. Arrow-leaved Violet. Rare in some sections, common in others. Howard City and Baldwin, W. J. B.; Keweenaw Co., O. A. Farwell. Th.

*1493. **V. scabriuscula** (T. & G.) Schwein. Smoothish Yellow Violet. *V. pubescens scabriuscula* T. & G. Frequent.

1494. **V. Selkirkii** Pursh. Great-spurred Violet. Gillman; A. Gray; Keweenaw Co., O. A. Farwell. U. P.

1495. **V. septentrionalis** Greene. S. W., H. S. Pepoon.

1496. **V. sororia** Willd. Belle Isle, O. A. Farwell.

*1497. **V. striata** Aiton. Pale Violet. Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Southward. Common. Th.

1498. **V. Rafinesqueii** Greene. Field Pansy *V. tenella* Muhl. Croswell, W. W. Wier; Detroit, O. A. Farwell.

1499. **V. tricolor** L. Pansy. Heart's-ease. Keweenaw Co., O. A. Farwell.

1500. **V. villosa** Walt. Keweenaw Co., O. A. Farwell.

CALCEOLARIA Loefl. SOLEA Spreng. IONIDIUM Vent.

*1501. C. verticillata (Ort.) Kuntze. Nodding Violet. Green Violet. *Solea concolor* Ging. Hubbardston; Ann Arbor, Allm. Cat. Scarce and local. Near Grand Rapids, Miss E. J. Cole. C. & S.

CACTACEÆ Lindl. Cactus Family.

OPUNTIA Mill.

1502. O. humifusa Raf. Western Prickly Pear. *O. Rafinesquii* Engelm. Common in Newaygo Co. along the Muskegon River. Cedar Creek Tp., Muskegon Co., C. F. Wheeler; and a stunted variety on sand barrens near Greenville, J. Satterlee; also, northward into British Am., Engelmann.

THYMELEACEÆ Reichenb. Mezereon Family.

DIRCA L.

*1503. D. palustris L. Leather-wood. Moose-wood. Woods. The tough bark used for thongs by Indians. Ann Arbor, Winch. Cat.; South Haven, L. H. Bailey; Alma, C. A. Davis, and northward. Frequent. Th.

ELAEAGNACEÆ Lindl. Oleaster Family.

LEPARGYRAEA Raf. SHEPHERDIA Nutt.

*1504. L. Canadensis (L.) Greene. Canadian Buffalo-berry. *Shepherdia Canadensis* Nutt. Gravelly banks. "On the western islands in Lake Erie." Dr. D. Cooley; Ann Arbor, Winch. Cat.; South Haven, L. H. Bailey; Flint, and northward. Abundant at Petoskey. A common short shrub, L. Superior, Whitney Cat.; Benton Harbor, C. F. Wheeler. Th.

LYTHRACEÆ Lindl. Loosestrife Family.

DECODON Gmelin.

*1505. D. verticillatus (L.) Ell. Swamp Loosestrife. Crystal Lake, Montcalm Co.; Flint; Birmingham, Oakland Co.; South Haven; Orion; Grass Lake; Fife Lake, farthest station north known. Infrequent. L. P.

LYTHRUM L.

1506. L. alatum Pursh. Near Detroit, Cooley MS., O. A. Farwell; S. Mich., Wright Cat.; Kalamazoo, Tuthill; Bay, Tuscola and Huron Counties, C. A. Davis. Malden, Detroit River,—Maclagan Canadian Cat. O. A. Farwell

1507. L. Salicaria L. Purple Loosestrife. Detroit to Bay City, Port Huron, C. K. Dodge.

MELASTOMACEÆ R. Br. Meadow-Beauty Family.

RHEXIA L.

1508. R. Virginica L. Deer-grass. Muskegon, C. D. McLouth; S. W., H. S. Pepoon.

ONAGRACEÆ Dumort. Evening-primrose Family.

ISNARDIA L. LUDWIGIA L., in part.

1509. I. palustris L. Marsh Purslane. *Ludwigia palustris* Ell. Water Purslane. Common. L. P.

LUDWIGIA L.

1510. **L. alternifolia** L. Seed-box. Dr. Wright; near Detroit, Dr. Cooley; near Algonac, C. K. Dodge; S. W., H. S. Pepoon. S. W.
1511. **L. polycarpa** Short & Peter. Dr. Pitcher and Dr. Clark. St. Clair Co., A. F. Foerste, C. K. Dodge. C. & S.

CHAMAENERION Adans. EPILOBIUM L., in part.

*1512. **C. angustifolium** (L) Scop. Great Willow-herb. *Epilobium spicatum.* Lam. *E. angustifolium* L. Great Willow Herb Fire-weed. Springs up abundantly where forests have been burned over, hence one common name.
1512a. **C. angustifolium canescens** (Wood.) Trelease. Keweenaw Co., O. A. Farwell.

EPILOBIUM L.

1513. **E. adenocaulon** Haussk. Northern Willow-herb. Trelease, Revision of Epilobium, p. 95. Keweenaw Co., O. A. Farwell. Frequent.
*1514. **E. coloratum** Muhl. Purple-leaved Willow-herb. Common. Th.
1515. **E. Hornemanii** Reichenb. Hornman's Willow-herb. Upper Wisconsin and Michigan. A. Gray. U. P.
*1516. **E. lineare** Muhl. Linear-leaved Willow-herb. Hubbardston; Flint; Alma; Stanton, and north to L. Sup. Infrequent in C. and rare or not at all in S.
1517. **E. palustre** L. Marsh Willow-herb. Frequent in swamps.
1518. **E. paniculatum** Nutt. Panicled Willow-herb. Britton and Brown.
*1519. **E. strictum** Muhl. Soft Willow-herb. Hubbardston; Flint; Ann Arbor; Macomb Co., Alma; northward to Keweenaw Co., O. A. Farwell. Frequent.

ONAGRA Adans. ŒNOTHERA L., in part.

*1520. **O. biennis** (L.) Scop. Common Evening Primrose. *Oenothera biennis* L. Common. Th.
1521. **O. Oakesiana** (A. Gray.) Britton. Oakes Evening Primrose. *Oenothera biennis Oakesiana* A. Gray. Shores of the Great Lakes.

OENOTHERA L.

1522. **O. laciniata** Hill. *O. sinuata* L. Detroit, O. A. Farwell. Rare.
1523. **O. rhombipetala** Nutt. S. W., H. S. Pepoon.

KNEIFFIA Spach. ŒNOTHERA L., in part.

1524. **K. fruticosa** (L.) Raimann. Common Sundrops. *Oenothera fruticosa* L. Palo, Ionia Co.; Flint; Macomb Co.; Ann Arbor, Allmend. Cat.; Keweenaw Co., O. A. Farwell. Th.
1525. **K. pumila** (L.) Spach. Small Sundrop. *Oenothera pumila* L. Ontonagon Falls, Whitney Cat.; So. Mich., Wr. Cat.; Oscoda, shore Lake Huron. Infrequent. Th.

HARTMANNIA Spach. ŒNOTHERA L., in part.

1526. **H. speciosa** (Nutt.) Small. Showy Primrose. Bay City, G. M. Bradford.

GAURA L.

1527. **G. biennis** L. Biennial Gaura. Dr. Wright. Malden, Ont., Maclagan, Canadian Catalogue. Detroit, O. A. Farwell.
1528. **G. coccinea** Pursh. Scarlet Gaura. White Pigeon, W. J. B.

CIRCAEA L.

*1529. **C. alpina** L. Smaller Enchanter's Nightshade. Woods. Common. Th.
*1530. **C. Lutetiana** L. Enchanter's Nightshade. Woods. Very common. Th.

HALORAGIDACEÆ Kl. & Garcke. Water-Milfoil Family.

HIPPURIS L.

1531. **H. vulgaris** L. Mare's tail. L. Sup., Can. Cat.; S. Mich., Wright Cat.; Keweenaw Co., O. A. Farwell; Black River, Cheboygan Co., B. & K.; Escanaba, E. J. Hill. Rare. Th.

1532. **H. vulgaris fluviatilis** Hart. Keweenaw peninsula, Robbins; Indian River, Cheboygan Co., C. F. Wheeler.

PROSERPINACA L.

*1533. **P. palustris** L. Mermaid-Weed. In swamps along with Alopecurus aristulatus and Ludwigia palustris. Keweenaw Co., O. A. Farwell; Cheboygan Co., B. & K.; Ann Arbor, Huron, Tuscola, Alpena Counties, C. A. Davis.

MYRIOPHYLLUM L.

1534. **M. alterniflorum** DC. St. Clair River, W. S. Cooper; Bay Co., G. M. Bradford.

1535. **M. Farwellii** Morong. Farwell's Water-Milfoil. Keweenaw Co., O. A. Farwell.

1536. **M. heterophyllum** Michx. Loose-flowered Water-Milfoil. Fruitport, E. J. Hill; Huron R. at Ypsilanti, Lyons; Macomb Co., Cooley; Manistee, F. P. Daniels. Rare.

*1537. **M. spicatum** L. Spiked Water-Milfoil. Abundant, L. Sup., Can. Cat.; Black Lake, Cheboygan Co., B. & K.; Pine Lake, Ingham Co. Common. Th.

1538. **M. tenellum** Bigelow. Slender Water-Milfoil. Gray's Manual.

*1539. **M. verticillatum** L. Whorled Water-Milfoil. Hubbardston; Flint; Macomb Co.; S. Mich., Wright Cat. Common. L. P. Ann Arbor, Alma, C. A. Davis.

ARALIACEÆ Vent. Ginseng Family.

ARALIA L.

*1540. **A. hispida** Vent. Bristly Sarsaparilla. Wild Elder. In a peat bog near the Agricultural College; also on dry clay soil, lot 21, Collegeville, Ingham Co.; Washtenaw Co., Alma, C. A. Davis. Apparently not common south of the pine region.

*1541. **A. nudicaulis** L. Wild Sarsaparilla. Alma, Ann Arbor, C. A. Davis. Common. Th.

*1542. **A. racemosa** L. Spikenard. Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; Roscommon, Ann Arbor, C. A. Davis. Frequent. Th.

1543. **A. spinosa** L. Spreading from Detroit, O. A. Farwell.

PANAX L.

*1544. **P. quinquefolium** L. Ginseng. *Aralia quinquefolia* Decsne. & Planch. Sault Ste. Marie; Ludington; Stanton, formerly in great abundance; Hubbardston; Flint; Macomb Co.; southwest. Wright Cat. Th.

1545. **P. trifolium** L. Dwarf Ginseng or Ground-nut. *Aralia trifolia* Decsne. & Planch. Frequent northward to Keweenaw Co., O. A. Farwell. Th.

UNBELLIFERÆ B. Juss. Corrot Family.

DAUCUS L.

1546. **D. Carota** L. Wild Carrot. Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis; St. Clair Co., C. K. Dodge; near Grand Rapids, G. D. Sones.

ANGELICA L. Archangelica Hoffm.

*1547. **A. atropurpurea** L. Great-purple-stemmed Angelica. Alma, occasional in S., common in C. & N.; also L. Sup. Can. Cat. Th.

1548. **A. villosa** (Walt.) B. S. P. *A. hirsuta* Muhl. Emmet Co., Winch. Cat.; Pontiac; Detroit, Ann Arbor, C. A. Davis. Dry banks and open woods. Infrequent. L. P.

CONIOSELINUM Hoffm.

*1549. **C. Chinense** (L.) B. S. P. Hemlock Parsley. Ann Arbor, All. Cat.; Macomb Co.; Flint; Hubbardston and north, C. F. Wheeler. Infrequent. Th.

OXYPOLIS Raf. TIEDEMANNIA DC.

*1550. **O. rigidus** (L.) Britton. Cowbane. *Tiedemannia rigida* Coult. & Rose. Hubbardston; Ann Arbor, All. Cat. Not much N. of lat. 43. Infrequent. C. & S.

HERACLEUM L.

*1551. **H. lanatum** Michx. Low ground. Common. Th.

PASTINACA L.

*1552. **P. sativa** L. Wild Parsnip. Fields. Infrequent. Th.

IMPERATORIA L.

1553. **I. Ostruthium** L. Masterwort. Muskegon, C. D. McLouth.

POLYTAENIA DC.

1554. **P. Nuttallii** DC. Dr. Wright, also A. Gray. Rare. S.

FOENICULUM Adans.

1555. **F. Foeniculum** (L.) Karst. Fennel. Ballast grounds, Detroit, O. A. Farwell.

THASPIUM Nutt.

1556. **T. barbinode** (Michx.) Nutt. Hairy-jointed Meadow Parsnip. Jackson, S. H. Camp.

1557. **T. trifoliatum** (L.) Britton. Purple Meadow Parsnip. Confined to the two southern tiers of counties.

1558. **T. trifoliatum aureum** (Nutt.) Britton. Belle Isle, O. A. Farwell.

ERYNGIUM L.

1559. **E. aquaticum** L. Button Snakeroot. *E. yuccaefolium* Michx. White Pigeon, 1838, Dr. Wright, in University Herb; Sturgis, F. P. Daniels; S. W., H. S. Pepoon. Rare. S. W.

SANICULA L.

*1560. **S. Canadensis** L. Short-styled Snakeroot. *S. Marylandica Canadensis* Torr. Hubbardston; Flint; Ann Arbor; All. Cat.; Alma. Beech and maple woods. Infrequent. C. & S.

*1561. **S. gregaria** Bicknell. Clustered Snake-root. Alma, C. A. Davis; Agricultural College, C. F. Wheeler; Belle Isle, O. A. Farwell.

*1562. **S. Marylandica** L. Black Snake-root. Oak woods. Common. Th.

1563. **S. trifoliata** Bicknell. Large-fruited Snake-root. Alma, C. A. Davis and C. F. Wheeler.

TAENIDIA Drude. PIMPINELLA L., in part.

*1564. **T. integerrima** (L.) Drude. Yellow Pimpernel. *Pimpinella integerrima* A. Gray. Dry soil. Very abundant in Grand-Saginaw Valley. Th.

CHAEROPHYLLUM L.

*1565. **C. procumbens** (L.) Crantz. Spreading Chervil. Low woods. Frequent in Grand River Valley; Valley of the Raisin River near Dundee, C. F. Wheeler; Macomb Co. C. & S.

WASHINGTONIA Raf. Osmorrhiza Raf.

*1566. **W. Claytoni** (Michx.) Britton. Woolly Sweet-cicely. *Osmorrhiza brevistylis* DC. The prevailing species, Winchell; probably true of counties along the Huron shore. Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Common. Th.

*1567. **W. longistylis** (Torr.) Britton. Smoother Sweet-Cicely. *Osmorrhiza longistylis* DC. Alma, C. A. Davis; Bay Co., G. M. Bradford. Common. Th.

CONIUM L.

*1568. **C. maculatum** L. Poison Hemlock. St. Clair Co., C. K. Dodge. Infrequent in C. & S. Common at Mackinac, Winch. Cat.

SIUM L.

*1569. **S. cicutaefolium** Gmel. Water-Parsnip. Clinton Co.; S. Mich., Winch. Cat.; Alma, Ann Arbor, C. A. Davis. Frequent. Th.

ZIZIA Koch.

*1570. **Z. aurea** (L.) Koch. Golden Meadow-Parsnip. Low ground. Common. Th.

1571. **Z. cordata** (Walt.) DC. Heart-leaved Alexanders. Flint; Put-in-Bay and S. W., Dr. Wright; Barron Lake, Cass Co., C. F. Wheeler. Rare. C. & S.

CARUM L.

1572. **C Copticum** (L.) Benth. Ballast grounds. Detroit. O. A. Farwell.

*1573. **Carui** L. Caraway. Naturalized in many places.

CICUTA L.

*1574. **C. bulbifera** L. Bulb-bearing Water Hemlock. Swamps. Common. Th.

*1575. **C. maculata** L. Spotted Cowbane. Beaver Poison. Musquash Root. Th.

DERINGA Adans. Cryptotaenia DC.

*1576. **D. Canadensis** (L.) Kuntze. Hornwort. *Cryptotaenia Canadensis* DC. Low woods. Common. C. & S.

BERULA Hoffm.

1577. **B. erecta** (Huds.) Coville. Cut-leaved Water Parsnip. *B. angustifolia* Mert. & Koch. Winchell, and A. Gray; Kalamazoo, Tuthill; Manistee, F. P. Daniels. Infrequent. S.

HYDROCOTYLE L.

*1578. **H. Americana** L. American Marsh-Pennywort. Common in C.; Alma, C. A. Davis. L. P.

*1579. **H. umbellata** L. Umbellate Marsh-Pennywort. Woodward Lake, Ionia Co.; S. Mich., Wright Cat.; Alma, C. A. Davis. Either grows on sandy shores or is wholly aquatic with floating leaves.

ERIGENIA Nutt.

*1580. **E. bulbosa** (Michx.) Nutt. Harbinger of Spring. Common. C. & S.

CORNACEÆ Link. Dogwood Family.

CORNUS L.

*1581. **C. alternifolia** L. f. Alternate-leaved Cornel. Banks. Frequent. The dead stems bright yellow. Keweenaw Co., O. A. Farwell. Rare in Cheboygan Co., B. & K.; Alma, Ann Arbor, C. A. Davis. Th.

*1582. **C. Amomum** Mill. Silky Cornel. Kinnikinnik. *C. sericea* L. Near Detroit, O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Frequent. C. & S.

1583. **C. asperifolia** Michx. Rough-leaved Dogwood. Belle Isle, O. A. Farwell; Homer, C. F. Wheeler.

*1584. **C. Baileyi** Coulter & Evans. Bailey's Cornel. Petoskey, New Buffalo, C. F. Wheeler; abundant along E. shore of Lake Michigan on sand dunes, occasional in Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell.

*1585. **C. candidissima** Mill. Panicled Cornel. Common. L. P.

*1586. **C. Canadensis** L. Dwarf Cornel. Bunch-berry. Rare south. Constantine, C. F. Wheeler; Ann Arbor, G. D. Sones. Northward very common. Th.

1587. **C. circinata** L'Her. Round-leaved Dogwood. Klinger Lake; Hubbardston to Cheboygan Co., B. & K.; Alma, Ann Arbor, C. A. Davis and northward to Keweenaw Co., O. A. Farwell. Infrequent. Th.

*1588. **C. florida** L. Flowering Dogwood. Frequent as far north as Grand-Saginaw Valley, usually as a low tree in oak woods. C. & S.

*1589. **C. polygama** Raf. *C. purpuri* Koehne. Bay Co., G. M. Bradford; Detroit, O. A. Farwell.

1590. **C. stolonifera** Michx. Red-osier. Dogwood. Marshes, borders of streams. Very common. Th.

NYSSA L.

*1591. **N. sylvatica** Marsh. Pepperidge. Tupelo. Sour-Gum Tree. Frequent. Alma, Ann Arbor, C. A. Davis; Manistee, F. P. Daniels. L. P. Edges of swamps. Frequent.

PYROLACEÆ Agardh. Wintergreen Family.

PYROLA L.

1592. **P. asarifolia** Michx. Liver-leaf Wintergreen. *P. rotundifolia asarifolia* Hook. The Cove, L. Huron, Winch. Cat.

1593. **P. chlorantha** Swartz. Greenish-flowered Wintergreen. Pine woods. Alma. Rare south of lat. 43. Frequent northward. C. N. & N. R. R.

*1594. **P. elliptica** Nutt. Shin-leaf. Rich woods. Ann Arbor; Ionia Co.; northward to L. Superior. Common. Th.

1595. **P. minor** L. Lesser Wintergreen. Cold woods. L. Superior, A. Gray. L. P.

*1596. **P. rotundifolia** L. Round-leaved Wintergreen. Dry oak woods. Common. Th.

*1597. **P. secunda** L. One-sided Wintergreen. Rich woods. Common. Th. *P. secunda pumila* A. Gray. Grayling, G. H. Hicks; Oscoda; Cheboygan Co., B. & K.; Escanaba, E. J. Hill; Keweenaw Co., O. A. Farwell.

1598. **P. uliginosa** Torr. Bog Wintergreen. *P. rotundifolia uliginosa* A. Gray. L. Superior, Prof. J. Macoun; Quinnesec, E. J. Hill; Livingston Co., Alma, C. A. Davis; Keweenaw Co., O. A. Farwell; Cheboygan Co., Beardslee.

MONESES Salisb.

1599. **M. uniflora** (L.) A. Gray. One-flowered Wintergreen. *M. grahdiflora.* S. F. Gray. Pine forests. Montcalm Co.; Flint.; Indian River, Wheeler; Clarkston, G. H. Hicks; Fort Gratiot, Winch. Cat.; cedar swamps, Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; Escanaba, E. J. Hill. Rare. Th.

CHIMAPHILA Pursh.

1600. **C. maculata** (L.) Pursh. Spotted Wintergreen. Oak woods. Ionia; Bangor and South Haven, Van Buren Co.; Flint. Rare or local.

*1601. **C. umbellata** (L.) Nutt. Pipsissewa. Prince's Pine. Pine woods. Common. Th.

MONOTROPACEÆ Lindl. Indian-pipe Family.

PTEROSPORA Nutt.

1602. **P. Andromedea** Nutt. Giant Bird's-nest. Pine Drops. Sitting Rabbit, Winch. Cat.; Carp River, U. P., Whitney Cat.; Keweenaw Co., O. A. Farwell; East Tawas; Elk Rapids.

MONOTROPA L.

*1603. **M. uniflora** L. Indian Pipe. Corpse Plant. Damp woods. Frequent. Th.

HYPOPITYS Hill.

*1604. **H. Hypopitys** (L.) Small. Pine-sap. *Monotropa Hypopitys* L. Oak and pine woods. Macomb Co., Ft. Gratiot, Austin, to Ontonagon River, L. Superior, Whitney Cat.; Cheboygan Co., cedar swamp and hard woods, rare. B. & K.; Grayling, Hicks; Escanaba, E. J. Hill. Infrequent.

ERICACEÆ DC. Heath Family.

LEDUM L.

*1605. **L Groenlandicum** OEder. Labrador Tea. *L latifolium* Ait. Swamps and bogs. Common northward.

KALMIA L.

1606. **K. angustifolia** L. Sheep Laurel. Lambkill. Wicky. Harrisville, west to Portage Lake; Tawas City and Thunder Bay, common, Winch. Cat.; Crawford Co.

1607. **K. glauca** Ait. Pale Laurel. Bogs. S. Mich., Wright's Cat.; Ionia Co.; Macomb Co.; Crawford Co.; Long Lake, Cheboygan Co.; Manistee, F. P. Daniels; Bay Co., G. M. Bradford. Rare. B. & K. Northward. Infrequent. Th.

1608. **K. glauca rosmarinifolia** Pursh. Keweenaw Co., O. A. Farwell.

ANDROMEDA L.

*1609. **A. Polifolia** L. Wild Rosemary. Sphagnous swamps. S. Mich., Wright's Cat.; Ionia Co. and northward. Frequent. Th.

XOLISMA Raf. LYONIA Nutt.

*1610. **X. ligustrina** L. Britton. Privet-Andromeda. *Andromeda ligustrina* Muhl. Keweenaw Pt., Dr. Robbins.

CHAMAEDAPHNE Moench. CASSANDRA D. Don.

*1611. **C. Calyculata** (L.) Moench. Leather-leaf. *Cassandra calyculata* Don. Swamps. Common. Th.

EPIGAEA L.

*1612. **E. repens** L. Trailing Arbutus. Borders of marshes, and woods in sandy soil. Jackson, W. C. Hull; Niles, I. N. Mitchell. Rare S., frequent in C., and common northward.

GAULTHERIA L.

*1613. **G. procumbens** L. Creeping Wintergreen. Low woods and borders of swamps. Common. Th.

ARCTOSTAPHYLOS Adans.

1614. **A. Uva-Ursi** (L.) Spreng.Bearberry. Sandy soil. Abundant northward, but rare S. of lat. 43. Th.

VACCINIACEÆ Lindl. Huckleberry Family.

GAYLUSSACIA H. B. K.

*1615. **G. resinosa** (Ait.) Torr. & Gray. Black Huckleberry. Hillsides. Frequent. Th.

POLYCODIUM Raf. VACCINIUM L., in part.

1616. **P. stamineum** (L.) Greene. Deerberry. *Vaccinium stamineum* L. Ann Arbor, C. A. Davis.

VACCINIUM L.

1617. **V. atrococcum** (A. Gray) Heller. Keweenaw Co., O. A. Farwell.

1618. **V. caespitosum** Michx. Shores of Lake Superior and westward, A. Gray, Fl. N. A.; Lyons. U. & P.

*1619. **V. Canadense** Richards. Canada Blueberry. Swamps. Commonest species in Cheboygan Co., B. & K. Common. Th.

*1620. **V. corymbosum** L. Swamp Blueberry. *V. corymbosum amoenum* A. Gray. Swamps. Yielding abundantly; variable. Common. Th. Keweenaw Co., O. A. Farwell.

1621. **V. membranaceum** Dougl. Thin-leaved Bilberry. *V. myrtilloides* Hook. Damp woods. L. Superior, A. Gray, Fl. N. A.; Keweenaw Co., O. A. Farwell. U. P.

1622. **V. nigrum** (Wood) Britton. Low Black Blueberry. Keweenaw Co., O. A. Farwell.

1623. **V. ovalifolium** J. E. Smith. Oval-leaved Bilberry. Woods. L. Superior, S. shore, Robbins. U. P.

*1624. **V. Pennsylvanicum** Lam. Dwarf Blueberry. Dry hills and barrens. The lowest and earliest fruited of the blueberries, A. Gray. Very variable in color of fruit. Common. Th.

1625. **V. Pennsylvanicum angustifolium** (Ait.) A. Gray. Keweenaw Co., O. A. Farwell.

1626. **V. uliginosum** L. Bog Bilberry. Shores of Lake Superior, A. Gray; Isle Royale and White Fish Pt., L. Superior. Henry Billman. U. P.

1627. **V. vacillans** Kalm. Low Blueberry. Alma, Ann Arbor, C. A. Davis. Barrens. Infrequent. Th.

CHIOGENES Salisb.

*1628. **C. hispidula** (L.) T. & G. Creeping Snowberry. *C. serpyllifolia* Salisb. S. Mich., Wright's Cat.; Ionia Co.; Montealm Co.; Petoskey, Roscommon, Alma, C. A. Davis. Sphagnous swamps. Infrequent. Th.

OXYCOCCUS Hill. SCHOLLERA Roth.

*1629. **O. macrocarpus** (Ait.) Pers. Large Cranberry. *Vaccinium macrocarpon* Ait. Bogs. The common Cranberry of the market. Common. Th.

*1630. **O. Oxycoccus** (L.) MacM. Small Cranberry. *Vaccinium Oxycoccus* L. Sphagnous swamps. Ionia Co.; Alma, Ann Arbor, C. A. Davis; Constantine, C. F. Wheeler, and northward. Infrequent.

PRIMULACEÆ Vent. Primrose Family.

PRIMULA L.

1631. **P. farinosa** L. Bird's-eye Primrose. Pictured Rocks, G. H. Hicks; shores of Little Traverse Bay; Drummond's Island, Winch. Cat.; L. Superior, Whitney Cat.; Keweenaw Co., O. A. Farwell; Alpena, C. A. Davis.

*1632. **P. Mistassinica** Michx. S. E. University Herb; Lake Superior, Whitney Cat.; rocks, Grand Ledge; Presque Isle, Dr. Houghton; Eagle River, F. E. Wood. Rare.

ANDROSACE L.

1633. **A. occidentalis** Pursh. Androsace. Niles, Ralph Ballard.

SAMOLUS L.

*1634. **S. floribundus** H. B. K. Water Pimpernel. *S. Valerandi Americanus* A. Gray. Springy places. Common along Maple River; Flint; Alma; Macomb Co.; N. W., University Herb.

LYSIMACHIA L.

1635. **L. Nummularia** L. Moneywort. Escaped from cultivation. Monroe Co., C. F. Wheeler; Ypsilanti, O. A. Farwell; Alma, Tuscola Co., C. A. Davis.

1636. **L. producta** (A. Gray) Fernald. *L. stricta producta* A. Gray. In Herb. Gray from Mich., L. H. Bailey; Alma, C. A. Davis.

1637. **L. quadrifolia** L. Crosswort. Sandy soil. Ann Arbor. Winch. Cat.; Ionia Co.; Montcalm Co.; Flint; Macomb Co., Alma; northward to Oscoda Co. L. P.
*1638. **L. terrestris** (L.) B. S. P. Bulb-bearing Loosestrife. *L. stricta* Ait. Borders of marshes. Alma, Ann Arbor, C. A. Davis; Hubbardston, C. F. Wheeler.

STEIRONEMA Raf.

*1639. **S. ciliatum** (L.) Raf. Fringed Loosestrife. Swamps. Common. Th.
1640. **S. lanceolatum** (Walt.) A. Gray. Lance-leaved Loosestrife. Howard City, W. J. B,; Detroit, O. A. Farwell; low grounds, Cheboygan Co., B. & K.
*1642. **S. quadriflorum** (Sims) Hitchc. Prairie Moneywort. *S. longifolium* A. Gray. Banks of streams. Ann Arbor and Ft. Gratiot. Winch. Cat.; Ionia Co.; Flint. Frequent. L. P.

NAUMBERGIA Moench.

*1643. **N. thyrsiflora** (L.) Duby. Tufted Loosestrife. *Lysimachia thyrsiflora* L. Tufted Loosestrife. Swampy soil. Alma, Ann Arbor, C. A. Davis. Common.

TRIENTALIS L.

*1644. **T. Americana** (Pers.) Pursh. Star-flower. Damp woods. Common. Th.

ANAGALLIS L.

1645. **A. arvensis** L. Common Pimpernel. Ann Arbor, Mary H. Clark; St. Clair, C. K. Dodge; Detroit, O. A. Farwell.

DODECATHEON L.

1646. **D. Meadia** L. Shooting Star. Moist, shaded grounds, A. Gray, Dr. A. B. Lyons; Belle Isle, O. A. Farwell.

OLEACEÆ Lindl. Olive Family.

SYRINGA L.

1647. **S. Persica** L. Persian Lilac. Keweenaw Co., Detroit, O. A. Farwell.
1648. **S. vulgaris** L. Lilac. Keweenaw Co., Ypsilanti, O. A. Farwell. Escaped from cultivation.

FRAXINUS L.

*1649. **F. Americana** L. White Ash. Common. Th.
*1650. **F. lanceolata** Borck. Green Ash. *F. viridis* Michx. f. Alma, C. A. Davis; Ann Arbor, Winch. Cat.; and northward. Rare.
*1651. **F. nigra** Marsh. Black Ash. *F. sambucifolia* Lam. Common. Th.
*1652. **F. Pennsylvanica** Marsh. Red Ash. *F. pubescens* Lam. Low grounds. Ionia Co.; S. Mich., Wright. Cat.; Drummond's L. Winch. Cat.; along Black River, Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell Scarce.
*1653. **F. quadrangulata** Michx. Blue Ash. Rich woods. Infrequent. Ann Arbor, C. A. Davis; Lenawee Co., W. J. B.

GENTIANACEÆ Dumort. Gentian Family.

ERYTHRAEA Neck.

*1654. **E. Centaurium** (L.) Pers. Centaury. Agricultural College grounds, L. H. Bailey. The only locality known in the State.

SABBATIA Adans.

1655. **S. angularis** (L.) Pursh. Marshes, Cass Co., Univ. Herb., 1838; Goguac Lake, near Battle Creek, V. M. Spalding; S. Mich., Wright's Cat.; Berrien Co., E. F. Smith. Rare.

GENTIANA L.

*1656. **G. Andrewsii** Griesb. Closed Gentian. River banks. Frequent.

*1657. **G. crinata** Froel. Fringed Gentian. Low grounds, Lenawee Co., G. F. Comstock; Ann Arbor, Alma, C. A. Davis, Winch. Cat.; South Haven, L. H. Bailey; Mackinac, Whitney; Ionia Co. Frequent. Th.

*1658. **G. detonsa** Rottb. Samller Fringed Gentian. *G. serrata* Gunner. Tamarack swamps. Frequent. Th.

1659. **G. flavida** A. Gray. Yellowish Gentian. *G. alba* A. Gray. Low meadows and borders of woods. Ionia Co.; Clinton Co.; Ann Arbor and S. W., Winch. Cat.; to L. Superior. Rare or local.

1660. **G. linearis** Froel. Narrow-leaved Gentian. *A. latifolia* A. Gray. Keweenaw Co., O. A. Farwell; Escanaba, C. F. Wheeler. Creek bottoms.

*1661. **G. puberula** Michx. Downy Gentian. Barrens. Ann Arbor, Miss Clark, Miss Allmendinger. Rare. S.

1662. **G. quinquefolia** L. Stiff Gentian. Moist hillsides. Ann Arbor, Winch. Cat.; Ionia Co. Occasional. C. & S.

1663. **G. quinquefolia occidentalis** (A. Gray) A. S. Hitchcock. Lenawee Co., G. F. Comstock; Ann Arbor. Winch. Cat.; Hubbardston; Macomb Co. Infrequent.

1664. **G. rubricaulis** Schwein. Red-stemmed Gentian. *G. linearis lanceolata* A. Gray. Pt. au Chene, L. Mich., Winch. Cat.; low ground near Black Lake, Cheboygan Co., B. & K.; Minnesota and along L. Superior, A. Gray. N. & U. P.

1665. **G. Saponaria** L. Soapwort Gentian. Moist woods. Macomb Co.; S. Mich., Wright Cat.; St. Clair, C. K. Dodge. Infrequent. S.

FRASERA Walt.

*1666. **F. Carolinensis** Walt. American Columbo. Jackson Co., and westward, Winch. Cat.; Ann Arbor, Miss Clark; Constantine, Three Rivers, C. F. Wheeler; Ingham Co., W. J. B.; Sturgis, F. P. Daniels; Addison, O. C. McLouth; Lenawee Co., G. F. Comstock; Grand Rapids; Macomb Co.; S. W., H. S. Pepoon. Scarce. C. & S.

TETRAGONANTHUS G. Gmel. HALENIA Borck.

1667. **T. deflexus** (J. E. Smith) Kuntze. Spurred Gentian. *Halenia deflexa* Griseb. Shore of Little Traverse Bay, near Harbor Point; Drummond's Is. and St. Helen's Is., Winch. Cat.; northward to Lake Superior; shore Black Lake, Cheboygan Co.; Keweenaw Co., O. A. Farwell. Frequent.

1668. **T. deflexus Brentonianus** (Griseb.) Britton. Keweenaw Co., O. A. Farwell.

BARTONIA Muhl.

*1669. **B. Virginica** (L.) B. S. P. *B. tenella* Willd. Open woods. S. Mich., Wright Cat.; Algonac; Hubbardston; Flint; Grayling; St. Clair Co., C. K. Dodge; Grass Lake, C. A. Davis. Rare.

MENYANTHACEÆ G. Don. Buckbean Family.

MENYANTHES L.

*1670. **M. trifoliata** L. Buckbeam. Bogs. Th.

LIMNANTHEMUM Gmelin.

1671. **L. lacunosum** (Vent.) Griseb. Floating Hart. Keweenaw Pt., Dr. Robbins.

APOCYNACEÆ Lindl. Dogbane Family.

VINCA L.

1672. **V. minor** L. Periwinkle. Occasionally escaped from cultivation.

APOCYNUM L.

*1673. **A. androsaemifolium** L. Spreading Dogbane. Borders of woods. Common. Th.

*1674. **A. cannabinum** L. Indian Hemp. Low grounds. Exceedingly variable in size, habit, shape of leaves, pubescence. Common. Th.

*1675. **A. cannabinum glaberrimum** DC. Belle Isle, O. A. Farwell.

1676. **A. hypericifolium** Ait. Clasping-leaved Dogbane. Washington, Dr. D. Cooley; Flint, Dr. D. Clark; St. Clair Co., C. K. Dodge.

1677. **A. Milleri** Britton. Miller's Dogbane. Detroit, O. A. Farwell.

1678. **A. pubescens** R. Br. Velvet Dogbane. Detroit, O. A. Farwell.

ASCLEPIADACEÆ Lindl. Milkweed Family.

ASCLEPIAS L.

1679. **A. amplexicaulis** J. E. Smith. *A. obtusifolia* Michx. Baldwin, Lake Co., W. J. B.; Sturgis; Barron Lake, C. F. Wheeler; Niles, O. J. Stilwell. Rare.

*1680. **A. exaltata** (L.) Muhl. Poke Milkweed. *A. phytolaccoides* Pursh. Moist grounds. Ann Arbor; Ft. Gratiot, Winch. Cat.; Alma; Ionia Co.; Flint; Macomb Co. Infrequent. C. & S.

*1681. **A incarnata** L. Swamp Milkweed. Banks of streams. Common. Th.

1682. **A. pulchra** Ehrh. Hairy Milkweed. Hansen's Island. Algonac Co., J. W. Stacy.

1683. **A. purpurascens** L. Purple Milkweed. Woods. Ann Arbor, Winch. Cat.; Ionia Co.; Clinton Co.; Flint; Macomb Co.; Huron Co.; Tuscola Co. S. & S.

1684. **A. quadrifolia** Jacq. Four-leaved Milkweed. Ann Arbor, Winchell's Catalogue.

*1685. **A. Syriaca** L. Common Milkweed. *A. Cornuti* Dec. Fields. Common. Th.

1686. **A. Sullivantii** Engelm. Sullivan's Milkweed. Walpole Island, C. K. Dodge; Tuscola Co., C. A. Davis; Esserville, C. F. Wheeler.

*1687. **A. tuberosa** L. Butterfly-weed. Pleurisy-root. Sandy soil. Ranges from Canada to Florida and from the Saskatchewan Valley to Texas. Common.

1688. **A. verticillata** L. Whorled Milkweed. Barrens, S. Mich., Wright Cat.; Monroe Co., Grand Rapids, C. F. Wheeler; Washington, Macomb Co., Dr. D. Cooley.

ACERATES Ell.

1689. **A. Floridana** (Lam.) Hitchc. Florida Milkweed. *A. longifolia* Ell. South Haven, L. H. Bailey; Bay Co., G. M. Bradford; Detroit, O. A. Farwell; Tuscola Co., C. A. Davis.

1690. **A. viridiflora** (Raf.) Eaton. Green Milkweed. C. & S. Grand Rapids, Geo. D. Sones; Ft. Gratiot, Winch. Cat.; S. W., Wright Cat.; Ann Arbor, C. A. Davis; S. W., H. S. Pepoon; Detroit, O. A. Farwell. Rare.

CYNANCHUM L. VINCETOXICUM Walt., in part.

*1691. **C. nigrum** (L.) Pers. Black Swallow-wort. *Vincetoxicum nigrum* Moench. Escaped from cultivation on College grounds.

CONVOLVULACEÆ Vent. Morning-Glory Family.

CONVOLVULUS L.

1692. **C. Americanus** (Sims.) Greene. S. W., H. S. Pepoon.

*1693. **C. arvensis** L. Bindweed. Alma, Ann Arbor, C. A. Davis; Hubbardston; College grounds, along C. & G. T. R. R. Spreading.

1695. **C. hederacea** Wall. Chinese Morning glory. Bay City, G. M. Bradford.

*1696. **C. repens** L. Trailing Bindweed. *C. sepium repens* A. Gray. Frequent.

*1697. **C. sepium** L. Hedge Bindweed. Low grounds. Common. Th.

1698. **C. spithamaeus** L. Upright Bindweed. Sandy fields. Local. Th.

1698a. **C. stans** Michx. Keweenaw Co., O. A. Farwell.

IPOMOEA L.

1699. **I Pandurata** (L.) Meyer. Wild Potato-vine. Man-of-the-Earth. Win. Cat.; Niles, I. N. Mitchell; Coleman Cat.; Lenawee Co., W. J. B. Infrequent. S.

1700. **I. purpurea** (L.) Roth. Morning Glory Bay Co., G. M. Bradford; Ypsilanti, Detroit, O. A. Farwell; Alma, C. A. Davis; Ann Arbor. Escaped from cultivation.

CUSCUTACEÆ Dumort. Dodder Family.

CUSCUTA L.

*1701. **C. arvensis** Beyrich. Field Dodder. Lansing, C. F. Wheeler; Rochester, W. S. Cooper.

*1702. **C. Cephalanthi** Engelm. Button-bush Dodder. *C. tenuiflora* Elgelm. Maple River Valley; Coleman Cat.; on willows along Cedar River east of the College.

1703. **C. Coryli** Engelm. Hazel Dodder. *C. inflexa* Engelm. Port Huron, C. K. Dodge; Rochester and Algonac, W. S. Cooper.

1704. **C. Epithymum** Murr. Clover Dodder. Introduced at Salem, with alfalfa seed.

*1705. **C. Gronovii** Willd. Gronovius' Dodder. Low grounds. Frequent. C. & S.

1706. **C Polygonorum** Engelm. Smart-weed Dodder. *C. chlorocarpa* Engel. S. Haven, Mrs. Millington. S. & W.

POLEMONIACEÆ DC. Phlox Family.

PHLOX L.

1707. **P. bifida** Beck. Cleft Phlox. Rare. Shores of Barron Lake; Klinger Lake, the farthest station east known for this interesting plant. C. F. Wheeler. S. W.

*1708. **P. divaricata** L. Wild Blue Phlox. S. W., H. S. Pepoon; woods and fields, northward to Kingsley and Frankfort. Common. L. P.

1709. **P. paniculata** L. Garden Phlox. Keweenaw Co., O. A. Farwell. Introduced.

1710. **P. pilosa** L. Downy Phlox. Dry, sandy fields, Ann Arbor, Winch. Cat.; Ionia Co.; Flint; Macomb Co. Infrequent.

1711. **P. subulata** L. Ground or Moss Pink. S. Mich., Winch. Cat.; shore of Barron Lake, C. F. Wheeler; Belle Isle, O. A. Farwell. Common in cultivation.

HYDROPHYLLACEÆ Lindl. Water-leaf Family.

HYDROPHYLLUM L.

*1712. **H. appendiculatum** Michx. Appendaged Water-leaf. Moist hillsides and rich woods, northward to Frankfort. Frequent. L. P.

*1713. **H. Canadense** L. Broad-leaved Water-leaf. Damp, rich woods. Frequent. C. & S.

*1714. **H. Virginicum** L. Virginia Water-leaf. Rich woods. Frequent. C. & S.

PHACELIA Juss.

1715. **P. Franklinii** (R. Br.) A. Gray. Franklin's Phacelia. "Shores of L. Superior, especially on Isle Royale." A. Gray and Dr. A. B. Lyons. U. P.

BORAGINACEÆ Lindl. Borage Family.

CYNOGLOSSUM L.

*1716. **C. officinale** L. Common Hound's-Tongue. Roadsides. Frequent. Th.

*1717. **C. Virginicum** L. Wild Comfrey. Open woods, Comins, Oscoda Co.; Escanaba, where it replaces C. officinale as a weed, E. J. Hill. Frequent. Th.

LAPPULA Moench. ECHINOSPERMUM Sw.

1718. **L. Americana** (A. Gray) Rydberg. Nodding Stickseed. *Echinospermum deflexum Americanum* A. Gray. Cheboygan Co., B. & K.

*1720. **L. Lappula** (L.) Karst. Stickseed. *Echinospermum Lappula* Lehm. A worthless weed along roadsides and in waste places. Th.

*1721. **L. Virginiana** (L.) Greene. Virginia Stickseed. *Echinospermum Virginicum* Lehm. Woods. Frequent. Th.

MERTENSIA Roth.

1722. **M. paniculata** (Ait.) G. Don. Tall Lungwort. Whitney Cat.; Gray; Keweenaw Co., O. A. Farwell. U. P.

1723. **M. Virginica** (L.) DC. Virginia Cowslip. Lungwort. Blue Bells. Near Adrian, Mrs. I. H. Wheeler; S. E. of Grand Rapids, G. D. Sones. Rare.

MYOSOTIS L.

1724. **M. arvensis** (L.) Lehm. Field Scorpion Grass. Lapeer, Mrs. M. Owen.

1725. **M. laxa** Lehm. Smaller Forget-me-not. Lapeer, Mrs. M. Owen.

1726. **M. palustris** (L.) Lam. Escaped from gardens. Port Huron, M. Allenbruch.

*1727. **M. Virginica** (L.) B. S. P. Spring Scorpion Grass. *M. verna* Nutt. Winch. Cat.; Coleman Cat.; Flint, Dr. Clark; Ann Arbor, I. N. Mitchell; shore of Park Lake, Clinton Co., C. F. Wheeler. Rare. S.

LITHOSPERMUM L.

*1729. **L. arvense** L. Wheat-Thief. Red-root. Corn Gromwell. In Wheat fields. Introduced from the old world. Common. C. & S.

*1730. **L. canescens** (Michx.) Lehm. Puccoon of the Indians. Sandy fields, Ann Arbor, Winch. Cat.; Ionia Co.; Macomb Co., and northward. Th.

*1731. **L. Gmelini** (Michx.) Hitch. Hairy Puccoon. *L. hirtum* Lehm. Light sand. Tuscola Co., C. A. Davis; Bay Co., G. M. Bradford; Berrien Co., H. S. Pepoon.

*1732. **L. latifolium** Michx. American Gromwell. Borders of woods S. Mich., Winch. Cat.; Ionia Co.; Flint; Bois Blanc and other islands in Detroit River; Maclagan, Canadian Catalogue. Frequent. C. & S.

1732a. **L. linearifolium** Goldie. Narrow-leaved Puccoon. *L. angustifolium* Michx., not Forsk. Dr. A. B. Lyons; "Mich.," Gray's Manual; Port Huron, C. K. Dodge.

*1733. **L. officinale** L. Common Gromwell. Roadsides. Tuscola Co., C. A. Davis. Infrequent. Th.

ONOSMODIUM Michx.

1734. **O. molle** Michx. Soft-haired False Gromwell. *O. Carolinianum molle* A. Gray. Only noticed by Dr. D. Cooley, Macomb Co.

SYMPHYTUM L.

*1735. **S. officinale** L. Common Comfrey. Escaped from gardens. Infrequent.

BORAGO L.

1736. **B. officinalis** L. A weed in parts of St. Clair Co., C. K. Dodge.

ECHIUM L.

1737. **E. vulgare** L. Blue-weed. Vulcan, E. J. Hill; Bay Co., G. M. Bradford.

VERBENACEÆ J. St. Hil. Vervain Family.

VERBENA L.

1738. **V. angustifolia** Michx. Narrow-leaved Vervain. Dry grounds. Winch. Cat. S.

1739. **V. bracteosa** Michx. Large-bracted Vervain. Waste places. Coleman Cat.; Kalamazoo, L. H. Bailey; Port Huron, C. K. Dodge; Manistee, F. P. Daniels; Roscommon Co., C. A. Davis.

1740. **V. bracteosa x stricta.** Near Port Huron, C. K. Dodge.
*1741. **V. hastata** L. Blue Vervian. Roadsides. Common. Th.
1742. **V. hastata oblongifolia** Nutt. *V. urticifolia riparia* (Raf.) Britton. A probable hybrid between V. hastata and V. urticifolia. South of Marshall, where no other species were found excepting the two last named. W. J. B.; Detroit, O. A. Farwell.
1744. **V. officinalis** L. Detroit, O. A. Farwell.
1745. **V. stricta** Vent. Mullein-leaved Vervain. Grand Rapids, H. C. Skeels; Port Huron, C. K. Dodge; Detroit, O. A. Farwell.
*1746. **V. urticifolia** L. White Vervain. Waste places. Common. Th.
1747. **V. urticifolia riparia** (Raf.) Britton. Detroit, O. A. Farwell.

LIPPIA L.

1748. **L. lanceolata** Michx. Fog-fruit. Coleman Cat.: Niles, I. N. Mitchell; Algonac, W. S. Cooper. S. W.

LABIATÆ B. Juss. Mint Family.

AJUGA L.

*1750. **A. reptans** L. Bugle. Bay City, G. M. Bradford.

TEUCRIUM L.

*1751. **T. Canadense** L. American Germander. Wood Sage. Low grounds. Infrequent at Black Lake, Cheboygan Co., B. & K. Alma, Ann Arbor, C. A. Davis. L. P.
1752. **T. menthifolium** Bickwell, Algonac, W. S. Cooper; Alma, where the type was collected.
1753. **T. occidentalis** A. Gray. Hairy Germander. Gaylord, G. L. Stewart.

SCUTELLARIA L.

1754. **S. cordifolia** Muhl. Heart-leaved Skullcap. *S. versicolor* Nutt. Banks of streams. S. Mich., Wright Cat.
*1755. **S. galericulata** L. Marsh Skullcap. Alma, C. A. Davis. Low grounds. Common. Th.
*1756. **S. lateriflora** L. Mad-dog Skullcap. Roscommon, Alma, Ann Arbor, C. A. Davis. Low grounds. Common. Th.
1757. **S. parvula** Michx. Small Skullcap. Ionia, E. F. Smith; islands east of Georgian Bay, Bell, Can. Cat. Infrequent.
1758. **S. pilosa** Michx. Hairy Skullcap. S. W., Winch. Cat.; Gray's Manual, 6th edition.

MARRUBIUM L.

*1759. **M. vulgare** L. Common Horehound. Roadsides, escaped from cultivation. Ionia Co.: Flint; S. Mich., Winch. Cat.: Port Austin; Grand Traverse and Benzie Counties. Frequent.

AGASTACHE Clayt. LOPHANTHUS Benth.

*1760. **A. nepetoides** (L.) Kuntze. Catnep Giant-Hyssop. *Lophanthus nepetoides* Benth. Low grounds. Ionia Co.; Flint; S. W., Wright Cat.; Grosse Isle, Miss Clark. C. & S. Infrequent.
1761. **A. scrophulariaefolia** (Willd.) Kuntze. Figwort. Giant-Hyssop. *Lophanthus scrophulariaefolius* Benth. Low grounds. . S. Mich., Wright Cat.; Lenawee Co., G. F. Comstock; Macomb Co.; Hubbardston. Infrequent. C. & S.

NEPETA L.

*1762. **N. Cataria** L. Catnep. Near dwellings. Common. Th.

GLECOMA L. NEPETA L., in part.

*1763. **G. hederacea** L. Gill-over-the-Ground. *Nepeta Glechoma* Benth. Sparingly escaped from culture. Flint; Grand Rapids, Coleman Cat.; Cassopolis; Alma; Ann Arbor. C. & S.

DRACOCEPHALUM L.

1764. **D. parviflorum** Nutt. American Dragon-head. This interesting plant was first detected in the Lower Peninsula in June, 1878, when it was found in Roscommon Co., south of Houghton Lake. Alcona Co.; Hubbardston, Ionia Co.; S. W., H. S. Pepoon. Rare southward.

PRUNELLA L. BRUNELLA.

1765. **P. vulgaris** L. Common Self-heal or Heal-all. *Brunella vulgaris* L. "Brunella" is not the correct name. Fields. Occasionally the flowers are white. Common. Th.

PHYSOSTEGIA Benth.

1766. **P. Virginiana** (L.) Benth. Wet grounds; varies greatly. Ann Arbor, Winch. Cat.; S. W., Wright Cat.; Alma; Muir; Kalamazoo, L. H. Bailey; Flint, Dr. Clark, northward to Keweenaw Co., O. A. Farwell.

GALEOPSIS L.

1767. **G. Ladanum** L. Red Hemp-Nettle. Ft. Gratiot and Sault de Ste. Marie, Winch. Cat.

1768. **G. Tetrahit** L. Common Hemp-Nettle. Rare in C. of the State. Abundant at Mackinac, Winch. Cat.; Cheboygan Co., B. & K.; Alma; Harbor Springs, C. F. Wheeler. Th.

LEONURUS L.

*1769. **L. Cardiaca** L. Common Motherwort. Waste grounds. Common.

LAMIUM L.

*1770. **L. amplexicaule** L. Dead Nettle. Naturalized in gardens. In fields west of Ann Arbor, C. A. Davis.

1771. **L. maculatum** L. Escaped from cultivation. St. Clair Co., C. K. Dodge.

STACHYS L.

1772. **S. aspera** Michx. Rough Hedge Nettle. Alma, Ann Arbor, C. A. Davis. Wet grounds. Infrequent. L. P.

*1773. **S. aspera glabra** Gray. Rare.

1774. **S. hyssopifolia** Michx. Hyssop Hedge Nettle. Wet grounds. S. Mich., Wright Cat.; Stanton, E. J. Quackenbush. Rare. Th.

1775. **S. palustris** L. Hedge Nettle. Keweenaw Co., O. A. Farwell.

MONARDA L.

1776. **M. didyma** L. Bee-Balm. Oswego Tea. Rare in Michigan. Barron Lake, C. F. Wheeler; Flint, Dr. Clark; St. Clair Co., C. K. Dodge. S. W.

*1777. **M. fistulosa** L. Wild Bergamot. Sandy soil. Common. Th.

1778. **M. media** Willd. Purple Bergamot. Near Detroit, O. A. Farwell.

1779. **M. mollis** L. Pale Wild Bergamot. *M. scabra* Beck. Port Huron, C. K. Dodge; Ypsilanti, Belle Isle, O. A. Farwell.

1780. **M. punctata** L. Horse-Mint. Sandy soil. S. Mich., Wright Cat.; S. Haven, L. H. Bailey; Grand Haven, G. D. Sones. Infrequent. S.

BLEPHILIA Raf.

*1781. **B. ciliata** (L.) Raf. Dry ground. Ionia Co.; Ann Arbor, and Sault de Ste. Marie, Winch. Cat. Scarce. Th.

*1782. **B. hirsuta** (Pursh.) Torr. Hairy Blephilia. Low woods. S. Mich., Wright Cat.; Alma; Ionia Co. C. & S.

HEDEOMA Pers.

1783. **H. hispida** Pursh. Rochester, O. A. Farwell.

*1784. **H. pulegioides** (L.) Pers. American Pennyroyal. Fields. Hubbardston; Rochester; S. Mich., Wright Cat.; Macomb Co.; Lenawee Co., W. J. B. C. & S.

SATUREIA L.

1785. **S. hortensis** L. Summer Savory. St. Clair Co. near Capac, C. K. Dodge.

CLINOPODIUM L. CALAMINTHA Moench.

1786. **C. glabrum** (Nutt.) Kuntze. Low Calamint. *Calamintha Nuttallii* Benth. Drummond's Island, and northward, common. Not seen in C. of the State; S. E., Wright Cat.

*1787. **C. vulgare** L. White Basil. *Calamintha Clinopodium* Benth. Fields. Ionia Co.; Fort Gratiot, Winch. Cat., and northward to Lake Superior. Th.

HYSSOPUS L.

1788. **H. officinalis** L. Escaped from gardens. Flint; S. W., Winch. Cat.

KOELLIA Moench. PYCNANTHEMUM Michx.

*1789. **K. flexuosa** (Walt.) MacM. Narrow-leaved Mountain-Mint. *Pycnanthemum linifolium* Pursh. Detroit, O. A. Farwell; Manistee, F. P. Daniels.

1790. **K. Virginiana** (L.) MacM. Virginia Mountain-Mint. *Pycnanthemum lanceolantum* Pursh. Low grounds. Ionia Co.; Flint; Macomb Co.; S. W., H. S. Pepoon, and southward. Frequent. C. & S.

THYMUS L.

1791. **T. Serpyllum** L. Creeping Thyme. Flint, Coleman Cat. Rarely escaped from gardens.

*1792. **T. vulgaris** L. Common Thyme. College grounds.

LYCOPUS L.

*1793. **L. Americanus** Muhl. Cut-leaved Water Hoarhound. *L. sinuatus* Ell. Frequent.

1793a. **L. communis** Bicknell. Bugle-weed. Alma, Ann Arbor, C. A. Davis. Low grounds. Common L. P.

1794. **L. lucidus** Turcz. Western Water Hoarhound. Port Huron, C. K. Dodge.

1794a. **L. Macrophyllus** Benth. Thin-leaved Bugle-weed. *L. membranacea* Bicknell. Keweenaw Co., O. Farwell.

1794b. **L. membranaceus** Bicknell. Thin-leaved Bugle-weed. "Mich." Britton's Manual.

1795. **L. rubellus** Moench. Water Hoarhound. Clinton Co., E. F. Smith; St. Clair Co., Brotherton; Detroit, O. A. Farwell.

MENTHA L.

1797. **M. arvensis** L. Corn Mint. Algonac, C. K. Dodge.

*1798. **M. Canadensis** L. Wild Mint. Low grounds. Common. Th.

1799. **M. Canadensis glabrata** Benth. Keweenaw Co., O. A. Farwell.

1800. **M. citrata** Ehrh. Bergamot Mint. Algonac, Walpole Island, C. K. Dodge.

*1801. **M. piperita** L. Peppermint. Along streams. Extensively cultivated in St. Joseph and Wayne Counties for the oil. Common. Th.

1802. **M. sativa** L. Marsh Whorled Mint. Sturgis, F. P. Daniels.

*1803. **M. spicata** L. Spearmint. *M. viridis* L. Roadsides. Escaped from cultivation. Frequent.

COLLINSONIA L.

*1804. **C. Canadensis** L. Stone-root. Rich-weed. Rich woods. Ionia Co.; Flint; Detroit; Ann Arbor, and S. W., Winch. Cat. Frequent. C. & S.

SOLANACEÆ Pers. Potato Family.

PHYSALODES Boehm. NICANDRA Adans.

*1805. **P. physalodes** (L.) Britton. Apple-of-Peru. *Nicandra physalodes* Gaertn. Gardens. Ann Arbor, Winch. Cat.; Flint; Ionia Co.; Detroit, O. A. Farwell. Scarce.

PHYSALIS L.

1806. **P. heterophylla** Nees. Ground-Cherry. Detroit and Orion, O. A. Farwell; S. W., H. S. Pepoon.

1807. **P. heterophylla ambigua** (A. Gray) Rydberg. *P. Virginiana ambigua* A. Gray. Belle Isle and Keweenaw Co., O. A. Farwell.

1808. **P. heterophylla nyctaginea** (Dunal.) Rydberg. Howard City, W. J. B.; Barron Lake, Ronald, C. F. Wheeler.

1809. **P. ixocarpa** Brot. Tomatillo. Port Huron, C. K. Dodge.

*1810. **P. lanceolata** Michx. Prairie Ground-Cherry. Sandy soil. S. W., H. S. Pepoon; Ionia Co.; Alma. Frequent. Th.

1811. **P. Philadelphica** Lam. Philadelphia Ground-Cherry. Muskegon, C. D. McLouth; Belle Isle, O. A. Farwell.

1812. **P. pubescens** L. Low Hairy Ground-Cherry. Naturalized in West Bay City, G. M. Bradford.

*1813. **P Virginiana** Mill. Virginia Ground-Cherry. Light, sandy soil. Common. Th.

1814. **P. Virginiana vulgaris** Rydb. Grand Rapids, H. C. Skeels; Muskegon, W. J. B.; White Cloud, C. F. Wheeler.

LEUCOPHYSALIS Rydberg.

1815. **L. grandiflora** (Hook.) Rydberg. Large White-flowered Ground-Cherry. *Physalis grandiflora* Hook. "Clearings." First collected in L. P. near Farwell, in June, 1876, where it seemed to be at home. Near the mouth of the Au Sable River, Iosco Co., June, 1878, C. B. Cochran; "S. shore of L. Superior," A. Gray; Keweenaw Co., O. A. Farwell; Escanaba, E. J. Hill; Indian River, C. F Wheeler. N. & U. P.

SOLANUM L.

*1816. **S. Carolinense** L. Horse-Nettle. Introduced from the southwest; Port Huron, C. K. Dodge.

*1817. **S. Dulcamara** L. Bittersweet. Nightshade. Becoming common, especially in low land and swamps. C. & S.

*1818. **S. nigrum** L. Black Nightshade. Moist, cultivated fields. Common. C. & S.

*1819. **S. rostratum** Dunal. Beaked Nightshade. Introduced from the southwest.

LYCIUM L.

*1820. **L. vulgare** (Ait. f.) Dunal. Matrimony Vine. Escaped from gardens in places.

HYOSCYAMUS L.

1821. **H. niger** L. Black Henbane. Macomb Co.; Ft. Gratiot; Mackinac, abundant, Winch. Cat.

DATURA L.

1822. **D. Metel** L. Ypsilanti and Detroit, O. A. Farwell. Waste grounds. Rare.

*1823. **D. Stramonium** L. Common Stramonium, or Thorn-Apple. Alma, Ann Arbor, C. A. Davis; Port Huron, C. K. Dodge. Roadsides. Frequent. C. & S.

*1824. **D. Tatula** L. Purple Thorn-Apple. Flint; Macomb Co.; Berrien Co., H. S. Pepoon; Alma, Ann Arbor, C. A. Davis. C. & S.

NICOTIANA L.

1825. **N. rustica** L. Wild Tobacco. Emmet Co., cultivated by the Indians, Winch. Cat.

PETUNIA Juss.

1826. **P. axillaris** (Lam.) B. S. P. White Petunia. Waste places. Ypsilanti and Detroit, O. A. Farwell.

SCROPHULARIACEÆ Lindl. Figwort Family.

VERBASCUM L.

*1827. **V. Blattaria** L. Moth Mullein. Roadsides. S. Mich.; Ionia Co.; Detroit; Sturgis, F. P. Daniels; Alma, Ann Arbor, C. A. Davis.

*1828. **V. Thapsus** L. Common Mullein. Fields and roadsides everywhere, a common weed. Cultivated in England under the name of Aaron's Rod. Th.

CYMBALARIA Medic.

1829. **C. Cymbalaria** (L.) Wettst. Kenilworth Ivy. Lake shore at Elk Rapids, W. S. Cooper.

LINARIA Hill.

*1830. **L. Canadensis** (L.) Dumont. Wild Toad-Flax. S. shore of Saginaw Bay, Winch. Cat.; barrens in Clare Co. Infrequent or wanting in C. and S. Mich. Grand Rapids, G. D. Sones; Ann Arbor, Grass Lake, C. A. Davis.

*1831. **L. Linaria** (L.) Karst. Butter-and-Eggs. *L. vulgaris* Mill. Alma, Ann Arbor, C. A. Davis. Roadsides. Spreading from cultivation.

CHAENORRHINUM Reichb. LINARIA Hill., in part.

1832. **C. minus** (L.) Lange. *Linaria minor* L. St. Clair Co., C. K. Dodge; Detroit, O. A. Farwell.

SCROPHULARIA L.

1833. **S. leporella** Bicknell. Hare Figwort. Port Huron, C. K. Dodge; Island Lake, Vestaburg, C. F. Wheeler.

*1834. **S. Marilandica** L. Maryland Figwort. *S. nodosa Marylandica* A. Gray. Rich soil. Keweenaw Co., Belle Isle, O. A. Farwell; Alma, Ann Arbor, C. A. Davis, and southward. Frequent. Th.

CHELONE L.

*1835. **C. glabra** L. Snake-head. Borders of streams. Alma, Ann Arbor, C. A. Davis. Frequent. Th.

PENTSTEMON Soland.

1836. **P. canescens** Britton. Beard-tongue. *P. laevigatus canescens* Britton. Detroit, O. A. Farwell.

1837. **P. Digitalis** (Sweet) Nutt. *P. laevigatus Digitalis* A. Gray. Near Adrian, Mrs. I. H. Wheeler.

*1838. **P. hirsutus** (L.) Willd. Hairy Beard-tongue. *P. pubescens* Solander. Dry soil. Ann Arbor, Winch. Cat.; to Mackinac, G. H. Hicks; Alma. Common. Th.

1839. **P. Pentstemon** (L.) Britton. Smooth Beard-tongue. *P. laevigatus* Soland. Grand Rapids, Mrs. A. J. Peters.

COLLINSIA Nutt.

1840. **C. parviflora** Dougl. Small-flowered Collinsia. "Shady, moist ground, Upper Michigan," Gray, Fl. N. A.; Keweenaw Co., O. A. Farwell.

*1841. **C. verna** Nutt. Blue-eyed Mary. A beautiful little fall annual with blue and white flowers. Moist woods. Ann Arbor, Winch. Cat.; S. W., Wright's Cat.; Ionia Co., and probably reaches its N. limits in Gratiot Co. C. & S.

MIMULUS L.

1842. **M. alatus** Soland. Sharp-winged Monkey-flower. Sturgis, F. P. Daniels, S. W.

1843. **M. Jamesii** T. & G. James' Mimulus. Abundant at Mackinac, Winch. Cat.; "Upper Michigan," A. Gray; Petoskey; Hubbardston, Wheeler; Grayling, G. H. Hicks; Comstock, Kalamazoo Co., Tuthill; rare southward; near Millers, Ind., Flora of Cook Co., Illinois. Th.

1844. **M. moschatus** Dougl. Musk-flower. Keweenaw Co., O. A. Farwell.

*1845. **M. ringens** L. Monkey-flower. Wet places. Common. Th.

GRATIOLA L.

1846. **G. Virginiana** L. Clammy Hedge-Hyssop. S. Mich., Winch. Cat.; Keweenaw Pt., Dr. Robbins. Rare.

ILYSANTHES Raf.

1847. **I. attenuata** (Muhl.) Small. Detroit, O. A. Farwell; Bay Co., G. M. Bradford.
*1848. **I. dubia** (L.) Barnhart. *I. gratioloides* (L.) Benth. Long-stalked False Pimpernel. Near Algonac, J. W. Stacey. Low grounds. Frequent. C. & S.

LIMOSELLA L.

1849. **L. tenuifolia** Hoffm. Narrow-leaved Mudwort. *L. aquatica tenuifolia* Hoffmann. U. P., Dr. A. B. Lyons.

SYNTHYRIS Benth. WULFENIA Greene not Jacq.

1850. **S. Bullii** (Eaton) Barnhart. *Wulfenia Houghtoniana* (Benth). Greene. Oak barrens. S. Mich., Wright's Cat.; Ionia Co., three miles S. of Saranac, probably reaches here its N. limits; Barry Co., L. H. Bailey; Sturgis, F. P. Daniels. Rare.

VERONICA L.

*1851. **V. agrestis** L. Field Speedwell. Sandy fields. Coleman Cat.; and Flint. Rare.
*1852. **V. Americana** Schweinitz. American Brooklime. Brooks. Common. Th.
*1853. **V. Anagallis-aquatica** L. Water Speedwell. In springs and brooks. Frequent. Th.
*1854. **V. arvensis** L. Corn Speedwell. Cultivated and waste grounds. Common. Th.
1855. **V. Byzantina** (Sibth. & Smith) B. S. P. Buxbaum's Speedwell. *V. Buxbaumii* Tenore. Waste grounds. Coleman Cat. Corunna, G. H. Hicks; Port Huron, C. K. Dodge.
*1856. **V. Chamaedrys** L. Germander Speedwell. Escaped from cultivation. Port Huron, C. K. Dodge.
1857. **V. officinalis** L. Common Speedwell. Dry hills. Ann Arbor, Winch. Cat.; Alma, Ann Arbor, C. A. Davis. Scarce. S.
*1858. **V. peregrina** L. Neckweed. Purslane Speedwell. Moist grounds everywhere. Common. Th.
*1859. **V. scutellata** L. Marsh Speedwell. Swamps. Frequent. Th.
*1860. **V. serpyllifolia** L. Thyme-leaved Speedwell. Open grounds. Frequent. Th.

LEPTANDRA Nutt.

*1861. **L. Virginica** (L.) Nutt. Culver's-root. *Veronica Virginica* L. Open woods. Common. Th.

BUCHNERA L.

1862. **B. Americana** L. Blue-Hearts. Moist sandy ground. S. W. Wright Cat.; Flint; Macomb Co., Coleman Cat. Infrequent. C. & S.

DASYSTOMA Raf. GERARDIA L., in part.

*1863. **D. flava** (L.) Wood. Downy False Fox glove. *Gerardia flava* L. Open woods. Frequent. C. & S.
1864. **D. laevigata** Raf. Entire-leaved False Fox glove. *Gerardia laevigata* Raf. Coleman's Cat.; Flint; Dr. Lyons. S.
*1865. **D. Pedicularia** (L.) Benth. Fern-leaved Fox glove. *Gerardia pedicularia* L. Woods. Frequent. L. P.
*1866. **D. Virginica** (L.) Britton. Smooth False Fox glove. *Gerardia quercifolia* Pursh. Oak woods. Frequent. C. & S.

GERARDIA L.

1867. **G. aspera** Dougl. Rough Purple Gerardia. "Plains and prairies, Mich.," A. Gray's Manual.
1868. **G. auriculata** Michx. Auricled Gerardia. Wright Cat. Rare. S.
*1869. **G. paupercula** (A. Gray) Britton. Small-flowered Gerardia. *G. purpurea*

paupercula A. Gray. Oakland Co.; shore of Park Lake, Clinton Co., C. F. Wheeler; St. Clair Co., W. S. Cooper.

1870. **G. purpurea** L. Purple Gerardia. Moist, sandy ground, near the Great Lakes; Port Huron, C. K. Dodge; Orion, O. A. Farwell. L. P.

1871. **G. tenuifolia** Vahl. Slender Gerardia. Ann Arbor, Winch. Cat., Macomb Co. Rare.

*1872. **G. tenuifolia asperula** A. Gray. Lenawee Co., G. F. Comstock; Flint; Dr. Clark.

CASTILLEJA Mutis.

*1873. **C. acuminata** (Pursh.) Spreng. Lance-leaved Painted Cup. *C. pallida septentrionalis* A. Gray. Lake Superior, A. Gray; Keweenaw Co., O. A. Farwell. U. P.

*1874. **C. coccinea** (L.) Spreng. Scarlet Painted Cup. Wet and dry grounds. Varies in color of bracts from scarlet to yellow. Common. Th.

EUPHRASIA L.

1875. **E. Canadensis** Townsend. Reported along Lake Superior as *E. officinalis Tartarica*.

PEDICULARIS L.

*1876. **P. Canadensis** L. Common Lousewort. Wood Betony. Moist banks and woodlands. Common. Th.

*1877. **P. lanceolata** Michx. Swamp Lousewort. Swamps. Frequent. Th.

RHINANTHUS L.

1878. **R. Crista-Galli** L. Yellow-Rattle. "Lake Superior," A. Gray. U. P.

MELAMPYRUM L.

1879. **M. latifolium** Muhl. Broad-leaved Cow-Wheat. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford.

*1880. **M. lineare** Lam. Narrow-leaved Cow-Wheat. *M. Americanum* Michx. Sandy woods. A form with broad, spear-shaped leaves is frequent. Common. Th.

LENTIBULARIACEÆ Lindl. Bladderwort Family.

UTRICULARIA L.

*1881. **U. cornuta** Michx. Horned Bladderwort. Shore of Pine Lake, Ingham Co.; Point Sable, Mason Co., C. E. St. John; Petoskey; Cheboygan Co., B. & K.; Keweenaw Co., O. A. Farwell; Alma, Ann Arbor, C. A. Davis. Th.

*1882. **U. gibba** L. Humped Bladderwort. Old Mission, Grand Traverse Co., E. J. Hill; shore of Park Lake, Clinton Co., C. F. Wheeler; Lenawee Co., G. F. Comstock; Sturgis, F. P. Daniels. Rare. L. P.

1883. **U. intermedia** Hayne. Flat-leaved Bladderwort. Shallow water. Ann Arbor, Winch. Cat.; Macomb Co.; Grand Rapids, Sones; northward to Black Lake, Cheboygan Co., B. & K., and Keweenaw Co., O. A. Farwell; Alma. Infrequent. Th.

1884. **U. minor** L. Smaller Bladderwort. Shallow water. Detroit River, D. H. Campbell; Ann Arbor, Winch. Cat.; Hillsdale, University Herb; Hubbardston; Montcalm Co.; northward. Rare.

*1885. **U. purpurea** Walt. Purple Bladderwort. Hamlin Lake, H. T. Blodgett; Marshall, W. J. B.; Pine Lake, Ingham Co., Grass Lake, C. F. Wheeler; Ann Arbor, C. A. Davis.

*1886. **U. resupinata** B. D. Greene. Reversed Bladderwort. Very abundant on the east shore of Woodward Lake, in Ionia Co., E. F. Smith; shore of Pine Lake, Ingham Co., also reported from Whitings, Ind.; Alma, C. A. Davis.

*1887. **U. vulgaris** L. Greater Bladderwort. Slow streams. Throat of corolla-orange, veined with brown-purple. Frequent. Th.

PINGUICULA L.

1888. **P. vulgaris** L. Butterwort. Wet rocks. Whitney's Catalogue; Isle Royale, Dr. A. B. Lyons; Pictured Rocks, abundant, G. H. Hicks. U. P.

OROBANCHACEÆ Lindl. Broom-rape Family.

THALESIA Raf. APHYLLON A. Gray.

1889. **T. fasciculata** (Nutt.) Britton. Yellow Cancer-root. *Aphyllon fasciculatum* A. Gray. "Sandy ground, Lake Michigan," A. Gray; sand dunes, Frankfort.
1890. **T. uniflora** (L.) Britton. Pale Broom-rape. Cancer-root. *Aphyllon uniflorum* Torr. & Gray. Damp woodlands, S. Mich., Wright Cat.; Ann Arbor, G. D. Sones; Flint; Grayling, G. H. Hicks; Lake Superior, Winch. Cat. Infrequent. Th.

CONOPHOLIS Wallr.

1891. **C. Americana** (L. f.) Wallr. Squaw-root. Moist woods. Ann Arbor; S. W. H. S. Pepoon; S. Mich. Wright Cat.; Ionia Co.; Flint; Alma; Macomb Co., northward to Keweenaw Co., F. Infrequent.

LEPTAMNIUM Raf. EPIFAGUS Nutt.

1892. **L. Virginianum** (L.) Raf. Beech-drops. *Epifagus Virginiana* Nutt. Beech woods. Ionia Co.; Flint; Macomb Co. Very common in Grand-Saginaw Valley.

BIGNONIACEÆ Pers. Trumpet-creeper Family.

CATALPA Scop.

1893. **C. speciosa** Warder. Sturgis, F. P. Daniels. Probably introduced from the south.

ACANTHACEÆ J. St. Hil. Acanthus Family.

RUELLIA L.

1894. **R. cilosa** Pursh. Hairy Ruellia. Dry grounds. Wright Cat. Detroit, O. A. Farwell. S.
1895. **R. strepens** L. Smooth Ruellia. Dry soil. Wright Cat. S.

DIANTHERA L.

1896. **D. Americana** L. Dense-flowered Water-willow. In shallow water. Ann Arbor, Winch. Cat.; Put-in-Bay; S. Haven, L. H. Bailey. S.

PHRYMACEÆ Schauer. Lopseed Family.

PHRYMA L.

*1897. **P. Leptostachya** L. Lopseed. Moist woods. Pt. au Chene, Winch. Cat.; Flint; Macomb Co.; Wright Cat.; Ionia Co.; Turin, Marquette Co., B. Barlow; Manistee, F. P. Daniels; Alma, Ann Arbor, C. A. Davis. C. & S.

PLANTAGINACEÆ Lindl. Plantain Family.

PLANTAGO L.

1898. **P. aristata** Michx. Large-bracted Plantain. Introduced with clover seed. Huron Co., C. A. Davis.
*1899. **P. cordata** Lam. Heart-leaved Plantain. Borders of streams. S. Mich., Wright Cat.; Tuscola Co., Winch. Cat.; Ionia Co.; Clinton Co.; Flint; Macomb Co. Frequent. C. & S.
*1900. **P. lanceolata** L. Ripplegrass. Ribgrass. English Plantain. Buck-horn. Meadows and fields. Too common. The seeds are often mixed with clover seed. Th.
*1901. **P. major** L. Common Plantain. Waysides and about dwellings everywhere. Common. Th.

1902. **P. media** L. Hoary Plantain. Bay City, G. M. Bradford.
1903. **P. Purshii** R. & S. S. W., H. S. Pepoon.
*1904. **P. Rugelii** Dec. Rugel's Plantain. Waste places. Often confounded with *P. major*. Frequent.
1905. **P. Virginica** L. White Dwarf Plantain. Algonac, C. K. Dodge.

RUBIACEÆ B. Juss. Madder Family.

HOUSTONIA L.

1906. **H. coerulea** L. Bluets. Innocence. Keweenaw Point, Dr. Robbins.
1907. **H. ciliolata** Torr. Fringed Houstonia. *H. purpurea ciliolata* A. Gray. Dr. Wright. Three Rivers, C. F. Wheeler; Ypsilanti, O. A. Farwell.
1908. **H. longifolia** Gaertn. Long-leaved Houstonia. *H. purpurea longifolia* A. Gray. Hastings, L. H. Bailey; Ionia, common; Clare Co., abundant to L. Sup., Can. Cat.; Vestaburg, Grass Lake, Ann Arbor, C. A. Davis. Th.

CEPHALANTHUS L.

*1909. **C. occidentalis** L. Button-bush. Swamps and flooded river bottoms. Common, Cheboygan Co., B. & K. Very common southward. L. P.

MITCHELLA L.

*1910. **M. repens** L. Partridge-berry. Prefers beech and maple, hemlock, or pine woods, and is seldom found under oaks. Common. Th.

GALIUM L.

*1911. **G. Aparine** L. Cleavers. Goose grass. Common. Th.
*1912. **G. asprellum** Michx. Rough Bedstraw. Frequent. Th.
*1913. **G. boreale** L. Northern Bedstraw. Very common. Th.
*1914. **G. circaezans** Michx. Wild Liquorice. Dry woods, Cheboygan Co., B. & K. Frequent southward. L. P.
1915. **G. Claytoni** Michx. Clayton's Bedstraw. Muskegon, C. D. McLouth; St. Clair Co., C. K. Dodge; Keweenaw Co., O. A. Farwell.
*1916. **G. concinnum** Torr. & Gray. Shining Bedstraw. Flint; Ann Arbor, All. Cat.; Grand Ledge. Rare. C. & S.
*1917. **G. lanceolatum** Torr. Wild Liquorice. Riverdale, Gratiot Co.; Hubbardston; Flint; Macomb Co.; and S. Mich. Wr. Cat.; also L. Superior, Whitney; Alma, Ann Arbor, C. A. Davis. Th.
*1918. **G. latifolium** Michx. Purple Bedstraw. Infrequent. C. & S.
1919. **G. Mollugo** L. Wild Madder. Bay City, G. M. Bradford.
*1920. **G. pilosum** Ait. Hairy Bedstraw. Frequent as far north as Grand-Saginaw Valley. C. & S.
1921. **G. tinctorium** L. Marshes, Bay Co., G. M. Bradford; Keweenaw Co., O. A. Farwell.
*1922. **G. trifidum** L. Small Bedstraw. Bogs. Common. Th.
*1923. **G. triflorum** Michx. Sweet-scented Bedstraw. Frequent in C. & S., and very abundant northward. Th.

CAPRIFOLIACEÆ Vent. Honeysuckle Family.

SAMBUCUS L.

*1924. **S. Canadensis** L. Common Elder. Follows settlements. Common.
*1925. **S. pubens** Michx. Red-berried Elder. *S. racemosa* HK. More northern in its range than the last. Variety with dissected leaves seen in Clare Co. Th.

VIBURNUM L.

*1926. **V. acerifolium** L. Arrow-wood. Dockmackie. Frequent in Cheboygan Co., B. & K.; Alma, Ann Arbor, C. A. Davis.
1927. **V. alnifolium** Marsh. Hobble-bush. American Wayfaring-tree. *V. lantanoides* Michx. Whitney found none of the sp. abundant in the U. P.

*1928. **V. cassinoides** L. Withe-rod. Macomb Co.: Hubbardston; Stanton; Riverdale; Gratiot Co.; Houghton Lake; to L. Superior. Commonest sp. about Black Lake, B. & K. Frequent. Th.

1929. **V. dentatum** L. Arrow-wood. Sarnia, Ont., C. K. Dodge.

*1930. **V. Lentago** L. Sweet Viburnum. Sheep-berry. Frequent. C. & S., and northward. Cheboygan Co.; Alma. Th.

*1931. **V. Opulus** L. Cranberry-tree. Swamps and borders of streams. Common. Th.

1932. **V. pauciflorum** Pylaie. Few-flowered Cranberry-tree. Dr. Lyons. Gray's Manual. Rare. U. P.

1933. **V. prunifolium** L. Black Haw. Dr. Lyons: Kalamazoo. Tuthill; Barron Lake, Cass Co., C. F. Wheeler; Detroit, O. A. Farwell. Rare. S.

*1934. **V. pubescens** (Ait.) Pursh. Downey Arrow-root. Common. Th.

TRIOSTEUM L.

1934a. **T. aurantiacum** Bicknell. Birmingham, O. A. Farwell.

*1935. **T. perfoliatum** L. Horse-Gentian. Clinton Co.: Ionia Co.; Flint: Macomb Co.; Black River, Cheboygan Co., one plant seen by B. & K. Frequent southward. L. P.

LINNAEA L.

*1936. **L. Americana** Forbes. Twin-flower. *L. borealis Michx.*, not L. Very abundant in N. & U. P.; south to Grand River Valley, and S. E. to Macomb Co.; Port Huron, C. K. Dodge. C. N. & U. P.

SYMPHORICARPOS Juss.

1937. **S. occidentalis** Hook. Wolfberry. Ft. Gratiot. Austin: N. Mich., A. Gray; Port Huron, C. K. Dodge. Rare. C. N. & U. P.

1938. **S. pauciflorus** (Robbins) Britton. Low Snowberry. *S. racemosus pauciflorus* Robbins. Harbor Springs: Keweenaw Co., Dr. Robbins; Hubbardston, C. F. Wheeler.

1939. **S. racemosus** Michx. Snowberry. Along the Great Lakes, Saginaw Bay and Alpena Co., Winchell; L. Sup., Can. Cat. C. N. & U. P.

1940. **S. Symphoricarpos** (L.) MacM. Coral-berry. Indian Currant. *S. vulgaris* Michx. Keweenaw Co., O. A. Farwell.

LONICERA L.

1941. **L. Caprifolium** L. Perfoliate Honeysuckle. *L. grata* Aiton. Dr. Lyons. Gray's Manual.

*1942. **L. ciliata** Muhl. Fly-Honeysuckle. Frequent. Th.

1943. **L. coerulea** L. Mountain Fly-Honeysuckle. Dr. Lyons. Keweenaw Co., O. A. Farwell: Clifton, F. E. Wood, in University Herb.

*1944. **L. dioica** L. Glaucous Honeysuckle. *L. glauca* Hill. Ionia: Montcalm Co.: Ann Arbor, All. Cat. Swamps or dry soil. Common. Th.

*1945. **L. glaucescens** Ryd. Douglas' Honeysuckle. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford.

1946. **L. hirsuta** Eaton. Hairy Honeysuckle. Alma, C. A. Davis. Frequent northward. C. N. & U. P.

1947. **L. involucrata** (Richards.) Banks. Mainland and Isle Royale; Keweenaw Co., O. A. Farwell; Ann Arbor, C. A. Davis.

*1948. **L. Japonica** Thunb. Japanese Honeysuckle. Lansing: Ypsilanti, O. A. Farwell.

*1949. **L. oblongifolia** (Goldie) Hook. Swamp F. Howell Junction, C. F. Wheeler; Macomb Co.; Stanton; Edmore; Isabella Co., Roscommon; Alma. More frequent in N. and U. P. Rare in S. Th.

1950. **L. Sullivantii** A. Gray. Keweenaw Co., O. A. Farwell.

*1951. **L. Tatarica** L. Tartarian Honeysuckle. Escaped from cultivation, Lansing; Detroit; Port Huron; Ypsilanti, O. A. Farwell.

1952. **L. Xylosteum** L. Escaped from cultivation. Detroit. O. A. Farwell.

DIERVILLA Moench.

*1953. **D. Diervilla** (L.) MacM. Bush Honeysuckle. *D. trifida* Moench. Rocky woods and bluffs. Common. Th.

VALERIANACEÆ Batsch. Valerian Family.

VALERIANA L.

1954. **V. edulis** Nutt. Tobacco-root. Ann Arbor and Macomb Co. Rare. S. E.
*1955. **V. uliginosa** (T. & G.) Rydb. Swamp Valerian. *V. sylvatica* Beck. not Banks. Sphagnous swamps, local. Th.

VALERIANELLA Poll.

1956. **V. chenopodifolia** (Pursh) DC. Goose-foot Corn Salad. Flint; Ionia; Lyons. Not common. C. & S.
1957. **V. radiata** (L.) Dufr. Beaked Corn Salad. Mich. A. Gray; Macomb Co., Cooley.

DIPSACACEÆ Lindl. Teasel Family.

DIPSACUS L.

*1958. **D. sylvestris** Huds. Wild Teasel. Fields and roadsides. Gratiot Co.; Ann Arbor; Detroit; Flint; Alma; Addison. Infrequent. C. & S.

CUCURBITACEÆ B. Juss. Gourd Family.

MICRAMPELIS Raf. ECHINOCYSTIS T. & G.

1959. **M. lobata** (Michx.) Greene. Wild Balsam Apple. *Echinocystis lobata* T. & G. Common in low woods along streams; Alma; Ionia; South Haven; Macomb Co.; Ann Arbor; Manistee, F. P. Daniels; Bay Co., G. M. Bradford.

SICYOS L.

1960. **S. angulatus** L. One-seeded Star Cucumber. Ypsilanti, O. A. Farwell; Port Huron, C. K. Dodge; Alma, Ann Arbor, C. A. Davis; Algonac, W. S. Cooper.

CAMPANULACEÆ Juss. Bellflower Family.

CAMPANULA L.

*1961. **C. Americana** L. Tall Bellflower. Moist woodlands. Ionia Co.; Flint; Macomb Co.; Ann Arbor, Winch. Cat.; Alma, C. A. Davis. Infrequent. C. & S.
*1962. **C. aparinoides** Pursh. Marsh Bellflower. Wet grassy grounds. Common. Th.
1963. **C. rapunculoides** L. Creeping European Bellflower. Ann Arbor, A. J. Pieters; Ypsilanti, O. A. Farwell; Bay Co., G. M. Bradford.
*1964. **C. rotundifolia** L. Harebell. Sandy banks and lake shores. Common. Th.
1965. **C. rotundifolia Langsdorfiana** (A. DC.) Britton. *C. rotundifolia alpina* Tuckerman. Keweenaw Co., O. A. Farwell; shore of Black Lake, Cheboygan Co., B. & K.; Petoskey, C. F. Wheeler.
1966. **C. rotundifolia velutina** DC. Sand hills of Burt Lake, E. J. Hill.

SPECULARIA Heist.

*1967. **S. perfoliata** (L.) A. DC. Venus' Looking-glass. Gravelly fields. Clinton Co.; S. E., University Herb.; Niles, I. N. Mitchell; Detroit, A. B. Lyons; Ann Arbor. Scarce. C. & S.

LOBELIA L.

*1968. **L. cardinalis** L. Cardinal-flower. River banks. Flowers rarely rose-color or even white. Common. Th.
1969. **L. Dortmanna** L. Water Lobelia. Isle Royale, Dr. A. B. Lyons. U. P.
*1970. **L. Kalmii** L. Kalm's Lobelia. Wet banks and rocks along shores. Ionia Co.; Ann Arbor; Oakland Co.; Petoskey; to L. Superior. Frequent. Th.

*1971. **L. inflata** L. Indian Tobacco. Pastures. Montcalm Co.; Flint; Macomb Co.; Oakland Co.; Put-in-Bay. Scarce. Th.
*1972. **L. spicata** Lam. Pale Spiked Lobelia. Oak openings. Frequent. Th.
1973. **L. spicata hirtella** A. Gray. Keweenaw Co., Detroit, O. A. Farwell.
*1974. **L. syphilitica** L. Great Lobelia. Low grounds. Flowers vary to white. Common. L. P.

CICHORIACEÆ Reichenb. Chicory Family.

CICHORIUM L.

*1975. **C. Intybus** L. Chicory. Ionia Co.; Flint: Detroit: Keweenaw Co., O. A. Farwell; Alma; Ann Arbor. Frequent. Th.

LAPSANA L.

*1976. **L. communis** L. Nipplewort. Campus of the Agricultural College.

ADOPOGON Neck. KRIGIA Schreb.

1977. **A. Carolinianum** (Walt.) Britton. Carolina Dwarf Dandelion. *Krigia Virginica* Willd. Barrens N. part of Clare Co.; Walton; Elk Rapids; Bay City. Rare.
*1978. **A. Virginicum** (L.) Kuntze. *Krigia amplexicaulis* Nutt. Moist hillsides. Frequent. L. P.

LEONTODON L.

1979. **L. autumnalis** L. Fall Dandelion. Well established at Hubbardston, C. F. Wheeler; Alma, C. A. Davis.

PICRIS L.

1980. **P. hieracioides** L. Hawkweed Picris. Detroit, O. A. Farwell.

TRAGOPOGON L.

1981. **T. porrifolius** L. Oyster Plant. Escaped from cultivation. St. Clair Co.; Alma; Keweenaw Co., O. A. Farwell.
*1982. **T. pratensis** L. Goat's Beard. Spreading. Hubbardston, C. F. Wheeler; Kalamazoo, Tuthill; Keweenaw Co., Ypsilanti, O. A. Farwell.

TARAXACUM Haller.

1983. **T. erythrospermum** Andrz. Red-seeded Dandelion. Detroit, O. A. Farwell.
*1984. **T. Taraxicum** (L.) Karst. Dandelion. *T. officinale* Weber. Fields everywhere.

SONCHUS L.

*1985. **S. arvensis** L. Field Sow-Thistle. Grand Rapids, Coleman's Cat.; Detroit, O. A. Farwell; Tuscola Co., C. A. Davis; Bay Co., C. M. Bradford.
*1986. **S. asper** (L.) Hill. Spiney-leaved Sow-Thistle. Alma, C. A. Davis. Waste places. Frequent.
*1987. **S. oleraceus** L. Common Sow-Thistle. Waste places. Macomb Co.; Montcalm Co.; Alma, C. A. Davis; northward to L. Superior. Frequent.

LACTUCA L.

*1988. **L. Canadensis** L. Wild Lettuce. Rich soil. Frequent. Th.
*1989. **L. Floridana** (L.) Gaertn. Florida Lettuce. Wayne Co., O. A. Farwell; Agricultural College, W. J. B.
*1990. **L. hirsuta** Muhl. Hairy Wood-lettuce. Infrequent. Hubbardston; Macomb Co., Cooley; Alma, Chelsea, C. A. Davis.
1991. **L. pulchella** (Purhs.) DC. Large-flowered Blue lettuce. "Upper Michigan," Prof. T. C. Porter; Caribou I.: Lake Huron, Dr. Todd; Detroit, O. A. Farwell; Keweenaw Co., O. A. Farwell. N. & U. P.
1992. **L. sagittifolia** Ell. Arrow-leaved Lettuce. *L. integrifolia* Bigel. Petoskey, C. F. Wheeler; Belle Isle, O. A. Farwell.

*1994. **L. spicata** (Lam.) Hitchc. Tall Blue Lettuce. *L. leucophaea* A. Gray. Frequent. Th.

1995. **L. spicata integrifolia** (T. & G.) Britton. *L. leucophaea integrifolia* T. & G. Belle Isle, Detroit, C. F. Wheeler.

*1995a. **L. virosa** L. Prickly Lettuce. Usually given the name *L. Scariola* L., which has pinnatifid leaves. Common.

CREPIS L.

*1996. **C. tectorum** L. Narrow-leaved Hawksbeard. Introduced.

HIERACIUM L.

*1997. **H. Canadense** Michx. Canada Hawkweed. Woods. Frequent. Th.

*1998. **H. Gronovii** L. Hairy Hawkweed. Dry soil. Ionia Co.; Flint; Macomb Co.; S. W. Mich., Wright Cat.; Alma. Infrequent. C. & S.

1999. **H. longipilum** Torr. Long-bearded Hawkweed. Fields. Macomb Co.; Traverse City, S. W., Wright Cat.; Grand Rapids, Coleman; Algonac, W. S. Cooper; Tuscola Co., C. A. Davis. Scarce. L. P.

2000. **H. Marianum** Willd. Maryland Hawkweed. Shore of Grand Traverse Bay, C. F. Wheeler.

*2001. **H. paniculatum** L. Panicled Hawkweed. Macomb Co.; S. Mich., Wright Cat. Scarce. C. & S.

2002. **H. Pilosella** L. Mouse-ear Hawkweed. Introduced at Benzonia, G. A. Clark.

*2003. **H. scabrum** Michx. Rough Hawkweed. Woods; Alma. Common. Th.

*2004. **H. umbellatum** L. Narrow-leaved Hawkweed. Marquette, C. F. Wheeler.

*2005. **H. venosum** L. Rattlesnake-weed. Dry soil in pine woods, or on oak land. Abundant at Point aux Pins, at the entrance to Lake Superior, Macoun, Can. Cat.; Port Austin, Ann Arbor, C. A. Davis. Frequent.

NABALUS Cass. PRENANTHES Vaill.

*2006. **N. albus** (L.) Hook. Rattlesnake-root. *Prenanthes alba* L. Woods. Common. Th.

*2007. **N. altissimus** (L.) Hook. Tall White Lettuce. *Prenanthes altissima* L. Rich woods. Frequent. Th.

*2008. **N. racemosus** (Michx.) DC. Glaucous White-Lettuce. *Prenanthes racemosa* Michx. Lenawee Co., G. F. Comstock; Flint; Macomb Co.; shore of L. Mich., near Sitting Rabbit, Winch. Cat.; S. W., Wright Cat.; Cheboygan Co., Beardslee, Keweenaw Co., Farwell; Kawkawlin, Ann Arbor, Grass Lake, Bay Port, C. A. Davis. Rare. Th.

2009. **N. trifoliatus** Cass. Tall Rattlesnake-root. Washington, Dr. D. Cooley.

AMBROSIACEÆ Reichenb. Ragweed Family.

IVA L.

2010. **I. xanthiifolia** (Fresen.) Nutt. Marsh Elder. Highwater-shrub. Keweenaw Co., O. A. Farwell. The farthest station east known.

AMBROSIA L.

*2011. **A. artemisiaefolia** L. Roman Wormwood. Ragweed. Hog-weed. Bitterweed. Roadsides. Introduced from the west. Abundant. Th.

2012. **A. psilostachya** DC. Manistee, F. P. Daniels; shore of Lake Huron, C. K. Dodge; Keweenaw Co., O. A. Farwell.

*2013. **A. trifida** L. Great Ragweed. Common. Low grounds along Grand and Maple Rivers; northward to Keweenaw Co., O. A. Farwell.

2014. **A. trifida integrifolia** T. & G. Low land. Keweenaw Co., O. A. Farwell. Th.

XANTHIUM L.

*2015. **X. Canadense** Mill. Common in waste places and along river banks.

2015a. **X. commune** Britton. Britton and Brown's Flora.

2016. **X. echinatum** Murr. *X. Canadense echinatum* A. Gray. Shores of Great Lakes.

2017. **X. glabratum** (DC.) Britton. Broad Cocklebur. *X. strumarium* of authors, not of Linnaeus. Detroit, O. A. Farwell.

X. Pennsylvanicum Wallr. Britton and Brown's Flora.

2018. **X. spinosum** L. Spiny Clotbur. Detroit. O. A. Farwell.

COMPOSITÆ Adans. Thistle Family.

VERNONIA Schreb.

2019. **V. Drummondii** Shuttlw. Drummond's Iron-weed. *V. altissima grandiflora* A. Gray. Frequent in the Grand River Valley; Bay Co., G. M. Bradford.

*2020. **V. fasciculata** Michx. River banks: Ionia Co.; Macomb Co.; Detroit. O. A. Farwell; Monroe Co.; Ann Arbor; South Haven. L. H. Bailey. Frequent. C. & S.

2021. **V. glauca** (L.) Britton. Broad-leaved Iron-weed. Three Rivers, C. F. Wheeler; Detroit, O. A. Farwell.

2022. **V. interior** Small. Detroit, O. A. Farwell.

2023. **V. maxima** Small. Tall Iron-weed. *V. gigantea* (Walt.) Britton. Detroit, O. A. Farwell; S. W., H. S. Pepoon. Frequent eastward.

2024. **V. Noveboracensis** (L.) Willd. Manistee, F. P. Daniels.

EUPATORIUM L.

*2025. **E. ageratoides** L. f. White Snake-root. Woods. Frequent. Th.

2026. **E. coelestinum** L. Mist-flower. "Rich soil. Mich." A. Gray's Manual.

2027. **E. maculatum** L. Spotted Joe-Pye Weed. Keweenaw Co., Rochester, O. A. Farwell; near Algonac. C. K. Dodge.

*2028. **E. perfoliatum** L. Thoroughwort. Boneset. Low grounds. Common. Th.

*2029. **E. purpureum** L. Joe-Pye Weed. Keweenaw Co., Rochester, O. A. Farwell. Th.

*2030. **E. purpureum falcatum** (Michx.) Britton. Keweenaw Co., O. A. Farwell.

2031. **E. sessilifolium** L. Upland Boneset. Copses. Macomb Co.; S. Mich., Winch. Cat. S.

2032. **E. trifoliatum** L. Rochester. O. A. Farwell.

WILLUGBAEYA Neck. MIKANIA Willd.

2033. **W. scandens** (L.) Kuntze. Climbing Hemp-weed. *Mikania scandens* Willd. Banks of Muskegon River for a distance of eleven miles above Black Lake. C. D. McLouth.

KUHNIA L.

2034. **K. eupatorioides** L. Ionia Co.; S. Mich., Winch. Cat. Infrequent. C. & S.

LACINARIA Hill. LIATRIS Schreb.

2035. **L. cylindracea** (Michx.) Kuntze. Cylindric Blazing Star. *Liatris cylindracea* Michx. Sterile open places: Ionia Co.; Macomb Co.; Lenawee Co., G. F. Comstock; Tuscola Co.; Grand Rapids to Keweenaw Co., O. A. Farwell. Not common. Th.

*2036. **L. scariosa** (L.) Hill. Large Button Snake-root. *Liatris scariosa* Willd. Rarely the flowers vary to white. Dry soil. Ann Arbor; northward to Keweenaw Co., O. A. Farwell. Frequent.

2036a. **L. scariosa corymbulosa** Sheldon. Orion, O. A. Farwell.

2037. **L. scariosa squarrulosa** (Michx.) Small. Orion, O. A. Farwell.

*2038. **L. spicata** (L.) Kuntze. Dense Button-Snakeroot. *Liatris spicata* Willd. Low grounds. Ionia Co.; Macomb Co.; near Port Huron, C. K. Dodge; Bay Co., G. M. Bradford; Kalamazoo, Tuthill. Infrequent.

GRINDELIA Willd.

2039. **G. squarrosa** (Pursh.) Dunal. Broad-leaved Gum-plant. Escanaba, R. E. Merrell; near Lapeer. Mrs. M. Owen; Marquette, O. A. Farwell. Occasionally introduced in grass seeds from the west.

SOLIDAGO L.

2040. **S. alpestris** Wald. & Kit. Alpine Golden-rod. *S. Virgaurea alpina* Bigel. Gray's Manual, 6th edition. U. P.

*2041. **S. bicolor** L. White Golden-rod. Rochester, W. A. Brotherton; Lansing, W. J. B.; Detroit, O. A. Farwell.

*2042. **S. caesia** L. Blue-stemmed Golden-rod. Rich woods. Frequent. L. P.

*2043. **S. caesia axillaris** (Pursh.) A. Gray. Frequent near Lansing. L. P.

*2044. **S. Canadensis** L. Canada Golden-rod. Fields. Our most variable and common golden-rod. Th.

*2045. **S. Canadensis procera** (Ait.) T. & G. Common.

2046. **S. Canadensis scabriuscula** T. C. Porter. Keweenaw Co., Detroit, O. A. Farwell.

2047. **S. erecta** Pursh. Slender Golden-rod. *S. speciosa angustata* T. & G. Indian River, Cheboygan Co., C. F. Wheeler.

*2048. **S. flexicaulis** L. Zig-Zag Golden-rod. *S. latifolia* L. Moist woods. Frequent. Th.

*2049. **S. hispida** Muhl. Hairy Golden-rod. *S. bicolor concolor* Torr & Gray. Dry places. Ionia Co.; Flint; Macomb Co.; Alma, Ann Arbor, C. A. Davis; and northward.

2050. **S. Houghtonii** Torr. & Gray. Houghton's Golden-rod. "N. shore of Lake Michigan," Gray's Man.; Drummond's Is., Winch. Cat.

*2051. **S. juncea** Ait. Early Golden-rod. Meadows and fields, variable. Frequent. Th.

2052. **S. juncea scabrella** (T. & G.) A. Gray. Orion, Detroit, O. A. Farwell.

2053. **S. macrophylla** Pursh. Large-leaved Golden-rod. "Shore of Lake Superior and northward," A. Gray's Manual, 6th edition. U. P.

2054. **S. neglecta** Torr. & Gray. Swamp Golden-rod. Swamps. Ionia Co., Orion, O. A. Farwell, and northward. Infrequent.

*2055. **S. nemoralis** Ait. Gray Golden-rod. Dry sandy soil. Common. Th.

2056. **S. Ohioensis** Riddell. Ohio Golden-rod. Moist meadows. Ionia Co.; Flint; Bay Co., G. M. Bradford; Macomb Co. to Grand Detour below Sugar Island, Prof. T. C. Porter. Infrequent.

*2057. **S. patula** Muhl. Rough-leaved Golden-rod. Borders of swamps. Common. C. & S.

2058. **S. Purshii** T. C. Porter. River bank Golden-rod. *S. humilis* Pursh. Frequent at Petoskey; Cheboygan Co., Beardslee; Keweenaw Co., O. A. Farwell.

*2059. **S. rigida** L. Stiff Golden-rod. Dry, sandy ground. Ann Anbor; Ionia Co.; Flint; Manistee, F. P. Daniels, and northward. Infrequent.

*2060. **S. Riddellii** Frank. Riddell's Golden-rod. Swamps, Ionia Co.; Macomb Co.; Detroit, O. A. Farwell; Ann Arbor, and southward. Rare.

*2061. **S. rugosa** Mill. Wrinkle-leaved Golden-rod. Borders of fields, northward to Thunder Bay, Macoun. Common. Th.

*2062. **S. serotina** Ait. Late Golden-rod. Shady places. Frequent. Th.

2063. **S. serotina gigantea** (Ait.) A. Gray. Borders of woods. Frequent. Th.

*2064. **S. speciosa** Nutt. Showy Golden-rod. Margin of woods on light soil. Ionia Co.; Flint; Macomb Co.; Ann Arbor; and northward to Keweenaw Co., O. A. Farwell. Infrequent.

*2065. **S. uliginosa** Nutt. Bog Golden-rod. Swamps. Ann Arbor, Tuscola Co., Alpena Co., C. A. Davis. Infrequent. Th.

*2066. **S. ulmifolia** Muhl. Elm-leaved Golden-rod. Borders of woods. Ionia Co.; Flint; Alma; S. W., Winch. Cat. Infrequent. L. P.

2067. **S. Virgaurea Gillmani** (A. Gray) T. C. Porter. *S. humilis Gillmani* A. Gray. Shores of Lake Mich., from New Buffalo to Mackinaw City, C. F. Wheeler.

EUTHAMIA Nutt.

2068. **E. Caroliniana** (L.) Greene. Slender Fragrant Golden-rod. *Solidago tenuifolia* Pursh. Grand Rapids, Miss E. J. Cole.

*2069. **E. graminifolia** (L.) Nutt. Bushy Golden-rod. *Solidago lanceolata* L. Moist soil. Alma, Ann Arbor, C. A. Davis. Common. Th.

ASTER L.

2069a. **A. amethystinus** Nutt. Detroit, O. A. Farwell.

*2070. **A. azureus** Lindl. Sky-blue Aster. Sterile soil. Flint; Ann Arbor; Ionia Co.; Bay Co., G. M. Bradford; Macomb Co. Infrequent. C. & S.

*2071. **A. cordifolius** L. Blue Wood Aster. *A. cordifolius polycephalus* T. C. Porter. Lansing, C. F. Wheeler; Bay Co., G. M. Bradford. Woods. Common. Th.

2072. **A. divaricatus** L. White Wood Aster. *A. corymbosus* Ait. Woods. Bay Co., G. M. Bradford. Infrequent. Th.

2073. **A. dumosus** L. Bushy Aster. Thickets. Macomb Co.; Petoskey, Dr. D. Clark; Hubbardston, not common, C. F. Wheeler; Cheboygan Co., Beardslee; Orion, O. A. Farwell; Alma, C. A. Davis. L. P.

2074. **A. ericoides** L. White Heath Aster. Petoskey, C. F. Wheeler; Bay Co., G. M. Bradford; shores of the Great Lakes.

2075. **A. ericoides pilosus** (Willd.) T. C. Porter. *A. ericoides villosus* T. & G. Marine City, C. K. Dodge.

2075a. **A. ericoides platyphyllus** T. & G. Detroit, O. A. Farwell.

2076. **A. exiguus** (Fernald) Rydb. Detroit, O. A. Farwell.

2078. **A. Faxoni** Porter. Faxon's Aster. *A. polyphyllus* Willd. Shores of the Great Lakes.

2079. **A. hirsuticaulis** Lindl. Hairy-stemmed Aster. *A. lateriflorus hirsutiusculis* T. C. Porter. Belle Isle, O. A. Farwell.

*2080. **A. junceus** Ait. Rush Aster. Tamarack swamps. Ionia Co.; Flint; Macomb Co.; Alma, Ann Arbor; northward. Frequent. Th.

*2081. **A. laevis** L. Smooth Aster. Border of oak woods. Cheboygan Co., B. & K.; Alma; Ann Arbor. Common southward. L. P.

2082. **A. laevis amplifolius** Porter. Detroit, Birmingham, O. A. Farwell.

2083. **A. lateriflorus** (L.) Britton. Starved Aster. *A. diffusus* Ait. Fields. Exceedingly variable. Common. Th.

2084. **A. lateriflorus glomerellus** (T. & G.) Burgess. Detroit, O. A. Farwell.

2085. **A. lateriflorus horizontalis** (Desf.) Burgess. Belle Isle, O. A. Farwell.

2085a. **A. lateriflorus pendulus** (Ait.) Burgess. Belle Isle, O. A. Farwell.

2086. **A. lateriflorus thyrsoideus** (A. Gray) Sheldon. *A. diffusus thyrsoides* A. Gray. Washington, Macomb Co., Dr. D. Cooley; Belle Isle, O. A. Farwell; and northward.

2087. **A. Lindleyanus** Torr. & Gray. Lindley's Aster. "Labrador to Lake Superior." A. Gray's Manual; Mackinaw City, C. F. Wheeler; Keweenaw Co., O. A. Farwell. Not common. N. & U. P.

2088. **A. longifolius** Lam. Long-leaved Aster. Escanaba, C. F. Wheeler.

2088a. **A. Lowrieanus** Porter. Lowrie's Aster. Lakeville, Brotherton and Farwell.

*2089. **A. macrophyllus** L. Large-leaved Aster. Woods. Common. Th.

*2090. **A. macrophyllus excelsior** Burgess. Keweenaw Co., O. A. Farwell.

2091. **A. multiflorus** Ait. Dense-flowered Aster. Sandy soil. Frequent. C. & S.

2092. **A. nemoralis** Ait. Common. Th.

*2093. **A. Novae-Angliae** L. New England Aster. Moist grounds. Frequent. Th.

2094. **A. Novi-Belgii** L. New York Aster. Detroit, O. A. Farwell.

2095. **A. oblongifolius** Nutt. Detroit, O. A. Farwell.

*2096. **A. paniculatus** Lam. Tall White Aster. Shady banks. Frequent. Th.

2098. **A. paniculatus bellidiflorus** (Willd.) Burgess. Belle Isle, C. F. Wheeler; Lapeer, Mrs. M. Owen.

2099. **A. paniculatus simplex** (Willd.) Burgess. Detroit, O. A. Farwell.

2100. **A. patens** Ait. Late Purple Aster. Dry grounds. Ann Arbor; Macomb Co. S. E.

2101. **A. prenanthoides** Muhl. Keweenaw Co., O. A. Farwell.

*2102. **A. ptarmicoides** (Nees.) Torr. and Gray. Macomb Co.; Clarkston, G. H. Hicks; Keweenaw Co., O. A. Farwell. Infrequent. Th.

*2103. **A. puniceus** L. Purple-stem Aster. Low grounds. Alma, Ann Arbor, C. A. Davis. Common. Th.

2103a. **A. puniceus firmus** (Nees) T. & G. Detroit, O. A. Farwell.

*2104. **A. puniceus lucidulus** Gray. Macomb Co. westward. Abundant.

*2105. **A. sagittifolius** Willd. Arrow-leaved Aster. Dry grounds. Frequent. Th.

2106. **A. sagittifolius urophyllus** (Lindl.) Burgess; Detroit, O. A. Farwell.

2107. **A. salicifolius** Lam. Willow Aster. Moist soil. Flint; Macomb Co., northward. Frequent.

2108. **A. sericeus** Vent. Silky Aster. S. Mich., Winch. Cat., Dr. D. Houghton; north to Keweenaw Co., O. A. Farwell. Rare.

2109. **A. Shortii** Hook. Short's Aster. Pewamo, C. F. Wheeler; Rochester, W. A. Brotherton. Rare.

*2110. **A. Tradescanti** L. Tradescant's Aster. Low grounds. Flint; Macomb Co. Frequent. L. P.

*2111. **A. undulatus** L. Wavy-leaf Aster. Dry copses. Flint; S. Mich.; Cheboygan Co., B. & K.; Ionia Co. Common. L. P.

*2112. **A. vimineus** Lam. Small White Aster. Low grounds. Cheboygan Co., Beardslee; Alma. Frequent southward. L. P.

2112a. **A. vimineus foliolosus** Ait. A. Gray. Detroit, O. A. Farwell.

BRACHYACTIS Ledeb.

2113. **B. angustus** (Lindl.) Britton. Rayless Aster. Port Huron, C. K. Dodge.

ERIGERON L.

2114. **E. acris** L. Blue Fleabane. Keweenaw Co., O. A. Farwell.

2115. **E. acris Droebachianus** (Retz) Willd. "Shores of Lake Superior," A. Gray; Dr. A. B. Lyons; Keweenaw Co., O. A. Farwell. U. P.

*2116. **E. annuus** (L.) Pers. Daisy Fleabane. Sweet Scabious. Fields. Common. Th.

2117. **E. asper** Nutt. Rough Erigeron. *E. glabellus* Nutt. Plains. Dr. A. B. Lyons. U. P.

2118. . **E. hyssopifolius** Michx. Hyssop-leaved Erigeron. "Lake Superior, and northward," A. Gray; Dr. Lyons; Keweenaw Co., O. A. Farwell.

*2119. **E. Philadelphicus** L. Common Philadelphia Fleabane. Common. Th.

*2120. **E. pulchellus** Michx. Robin's Plantain. *E. bellidifolius* Muhl. Moist banks. Frequent. C. & S.

*2121. **E. ramosus** (Walt.) B. S. P. Daisy Fleabane. *E. strigosus* Muhl. Fields. Common. Th.

LEPTILON Raf. ERIGERON L., in part.

2122. **L. Canadense** (L.) Britton. Horse-weed. *Erigeron Canadensis* L. Waste grounds. Common. Th.

2122a. **L. divaricatum** (Michx.) Raf. Near Detroit, O. A. Farwell.

DOELLINGERIA Nees.

*2123. **D. umbellata** (Mill.) Nees. Tall Flat-top White Aster. *Aster umbellatus* Mill. Moist places. Th.

2124. **D. umbellata pubens** (A. Gray) Britton. *Aster umbellatus pubens* A. Gray. Upper Mich., A. Gray's Manual; Cheboygan Co., Beardslee; Keweenaw Co., O. A. Farwell.

ANTENNARIA Gaertn.

2125. **A. ambigens** (Greene) Fernald. Bay Co., G. M. Bradford, Detroit, O. A. Farwell.

*2127. **A. campestris** Rydberg. Prairie Cat's-foot. Grayling, C. F. Wheeler; Manistee, F. P. Daniels.

2128. **A. Canadensis** Greene. Shores of Grand Traverse Bay under pines, C. F. Wheeler; Mackinac Island, O. A. Farwell.

2129. **A. fallax** Greene. Detroit, O. A. Farwell.

*2130. **A. Farwellii** Greene. Lansing, C. F. Wheeler; Keweenaw Co., O. A. Farwell; Manistee, F. P. Daniels.

*2131. **A. neglecta** Greene. Field Cat's-foot. Lansing, Brighton, Stockbridge, Wheeler & Longyear; Detroit, Ypsilanti, O. A. Farwell; Manistee, F. P. Daniels.

2131a. **A. neodioica** Greene. Keweenaw Co., O. A. Farwell.

*2132. **A. neodioica attenuata** Fernald. Agricultural College, Brighton, Vestaburg, C. F. Wheeler; Detroit, Mackinac Island, O. A. Farwell.

2133. **A. occidentalis** Greene. Shores of Grand Traverse Bay, C. F. Wheeler.

*2134. **A. Parlinii ambigens** Fernald. Banks of Cedar River at Agricultural College, C. F. Wheeler; Manistee, F. P. Daniels; Port Huron, C. K. Dodge.

*2135. **A. plantaginifolia** (L.) Richards. Plantain-leaved Everlasting. Dry fields. Common. Th.

ANAPHALIS DC.

2136. **A. margaritacea** (L.) Benth. & Hook. Pearly Everlasting. Montcalm Co.; Grayling, G. H. Hicks; Petoskey, Mackinac, C. F. Wheeler; Bay Co., G. M. Bradford.

GNAPHALIUM L.

*2137. **G. decurrens** Ives. Everlasting. Winged Cudweed. Fields. Alma, Ann Arbor, C. A. Davis. Abundant in the pine region, and northward.
*2138. **G. obtusifolium** L. Sweet Balsam. *G. polycephalum* Michx. Common Everlasting. Fields. Common. Th.
2139. **G. purpureum** L. Purplish Cudweed. Macomb and St. Clair Counties, A. F. Foerste; Detroit, O. A. Farwell.
*2140. **G. uliginosum** L. Low Cudweed. Roadsides in clay soil, abundant. Th.

ADENOCAULON Hook.

2141. **A. bicolor** Hook. Moist ground. Ontonagon River. U. P.

INULA L.

*2142. **I. Helenium** L. Elecampane. Roadsides, escaped from gardens. Infrequent.

POLYMNIA L.

*2143. **P. Canadensis** L. Small-flowered Leaf-cup. Shaded river banks. Ionia Co.; Macomb Co.; Flint; S. Michigan. Infrequent. C. & S.
2144. **P. Canadensis radiata** A. Gray. Rochester, O. A. Farwell.
2145. **P. Uvedalia** L. Large-flowered Leaf-cup. S. Michigan, Wright's Cat. S.

SILPHIUM L.

2146. **S. integrifolium** Michx. Entire-leaved Rosin-weed. S. W., University Herb.; Kalamazoo, Tuthill.
2147. **S. laciniatum** L. Rosin-weed. Compass-plant. S. Mich., Wright's Cat.; near Capac, J. W. Stacey. S.
2148. **S. perfoliatum** L. Cup-Plant. S. Mich., Wright's Cat.
2149. **S. terebinthinaceum** Jacq. Prairie Dock. Oak openings. Ionia; Macomb Co.; Ann Arbor; Sturgis, F. P. Daniels; S. W., H. S. Pepoon; Bay Co., G. M. Bradford. Infrequent. C. & S.
2150. **S. trifoliatum** L. Avon, W. A. Brotherton. Rare.
2150a. **H. helianthoides** (L.) B. S. P. Rochester, O. A. Farwell.

HELIOPSIS Pers.

2151. **H. scabra** Dunl. Rough Ox-Eye. Detroit, O. A. Farwell.

RUDBECKIA L.

*2152. **R. hirta** L. Black-eyed Susan. Meadows and low places, apparently introduced. Common. Th.
*2153. **R. laciniata** L. Tall Cone-flower. Low grounds. Frequent. Th.
*2154. **R. speciosa** Wenderoth. Flat-headed Cone-flower. Wet soil. Ionia Co.; Flint; Macomb Co.; Alma; Ann Arbor. Infrequent. C. & S.
2155. **R. triloba** L. Thin-leaved Cone-flower. Washington, Macomb Co., Cooley. Rare.

RATIBIDA Raf. LEPACHYS Raf.

*2156. **R. pinnata** (Vent.) Barnhart. Gray-headed Cone-flower. *Lepachis pinnata* Torr. & Gray. Dry ground. Ionia Co.; Grand Rapids; S. W., H. S. Pepoon. S. Mich. Infrequent. C. & S.

BRAUNERIA Neck. ECHINACEA Moench.

2157. **B. pallida** (Nutt.) Britton. Pale Purple Cone-flower. *Echinacea angustifolia* DC. Keweenaw Co., O. A. Farwell.
2158. **B. purpurea** (L.) Britton. Purple Cone-flower. *Echinacea purpurea* Moench. Univ. Herb. Harrington; Grand Rapids, Delia Bailey; St. Joseph, Dr. Houghton, 1838. Rare. S. W.

HELIANTHUS L.

*2159. **H. decapetalus** L. Thin-leaved Wild Sunflower. Low grounds. Frequent. L. P.

*2160. **H. divaricatus** L. Rough Sunflower. Dry woods. Common. Th.

*2161. **H. giganteus** L. Tall Sunflower. Low grounds; variable. Ionia Co.; Flint; Ann Arbor; Alma; Macomb Co., and northward. Common. Th.

2161a. **H. giganteus subtuberosus** (Bourg.) Britton. Rochester, Birmingham, O. A. Farwell.

2162. **H. grosseserratus** Martens. Saw-toothed Sunflower. Port Huron, C. K. Dodge; S. W., H. S. Pepoon.

2163. **H. hirsutus** Raf. Stiff-haired Sunflower. Dry soil. Ann Arbor, and S. W.

2164. **H. Maximiliani** Schrad. Adventive from the west. Bay Co., G. M. Bradford; Houghton, Detroit, O. A. Farwell.

2165. **H. microcephalus** T. & G. S. W., H. S. Pepoon.

2166. **H. mollis** Lam. Hairy Sunflower. Manistee, F. P. Daniels.

2167. **H. occidentalis** Riddell. Few-leaved Sunflower. Sterile soil. Ionia Co.; Flint; Grand Rapids; Macomb Co. Infrequent. C. & S.

2168. **H. petiolaris** Nutt. Prairie Sunflower. Introduced from the west to Hubbardston, C. F. Wheeler; Port Huron, C. K. Dodge.

2169. **H. scaberrimus** Ell. Stiff Sunflower. *H. rigidus* Desf. Dry soil. Ann Arbor, Winch. Cat. S.

*2170. **H. strumosus** L. Pale-leaved Wood Sunflower. Dry soil. Frequent. C. & S.

2171. **H. strumosus macrophyllus** (Willd.) Britton. *H. strumosus* var. *mollis* T. & G. Sturgis, F. P. Daniels.

2172. **H. tracheliifolius** Mill. Throatwort Sunflower. Copses. S. Mich., Wright's Cat.; Macomb Co., Dr. D. Cooley. C. & S.

*2173. **H. tuberosus** L. Jerusalem Artichoke. Sparingly escaped from gardens.

VERBESINA L. ACTINOMERIS Nutt.

2174. **V. alternifolia** (L.) Britton. *Actinomeris squarrosa* Nutt. Rich soil. S. Mich., Wright's Cat.; Dundee, C. F. Wheeler; Hudson, W. J. B.; islands in the Detroit River, Maclagan. Can Cat. S.

COREOPSIS L.

2175. **C. lanceolata** L. Lance-leaved Tickseed. *C. lanceolata angustifolia* T. & G. Sandy shores of Lake Huron; sand hills, Cheboygan Co., B. & K.; sandy plains near Baldwin, W. J. B.; south to Macomb Co., Cooley; Elk Rapids, W. S. Cooper. Th.

2176. **C. palmata** Nutt. Stiff Tickseed. S. Mich., Wright's Cat.; shore of Barron Lake, C. F. Wheeler, 1890; Gull Prairie, Dr. Houghton, 1838.

2177. **C. tinctoria** Nutt. Garden Tickseed. Bay City, G. M. Bradford.

2178. **C. tripteris** L. Tall Coreopsis. Tall Tickseed. Detroit; Macomb Co.; Oakland Co.; S. Mich., Wright's Cat.; Ionia; Grand Rapids; Ann Arbor. S.

2179. **C. verticillata** L. Whorled Tickseed. Samaria, Macomb Co., Grand Rapids, C. F. Wheeler.

BIDENS L.

2180. **B. aristosa** (Michx.) Britton. Belle Isle, O. A. Farwell.

*2180. **B. Beckii** Torr. Water Marigold. S. Mich., Wright's Cat.; Ann Arbor; Wexford Co., Cooley; Manistee, E. J. Hill; Indian River, C. F. Wheeler; Orion, O. A. Farwell; St. Clair Lake and River, C. K. Dodge. Rare.

*2182. **B. cernua** L. Smaller Bur-Marigold. Wet places. Cheboygan Co., Kofoid; Orion, Detroit, O. A. Farwell; Algonac, W. S. Cooper. Southward. Frequent. Th.

2182a. **B. cernua elliptica** Weigand, in part. Belle Isle, O. A. Farwell.

*2183. **B. laevis** (L.) B. S. P. Large Bur-Marigold. *B. chrysanthemoides* Michx. Swamps. Common. Th.

*2184. **B. comosa** (A. Gray) Wiegand. Leafy-bracted Tickseed. *B. connata comosa* A. Gray. Detroit, O. A. Farwell; Alma; Ann Arbor. Infrequent.

*2185. **B. connata** Muhl. Swamp Beggar-ticks. Low grounds. Common. Th.

2185a. **B. connata anomala** O. A. F. Awns upwardly barbed, O. A. F. Detroit, O. A. Farwell.

2185b. **B. connata petiolata** (Nutt.) O. A. F. Detroit, O. A. Farwell.

2186. **B. discoidea** (T. & G.) Britton. Small Beggar-ticks. *Coreopsis discoidea* Torr. & Gray. Wet ground. Ionia Co.; Manistee, F. P. Daniels. Scarce.

*2187. **B. frondosa** L. Common Beggar-ticks. Stick-tight. Low grounds. A troublesome weed. Common. Th.

2187a. **B. trichosperma** (Michx.) Britton. Orion, O. A. Farwell.

2188. **B. trichosperma tenuiloba** (A. Gray) Britton. *Corcopsis trichosperma tenuiloba* A. Gray. Swamps. Flint; Montcalm Co.; Ionia Co.; S. Mich., Wright's Cat.; Orion, O. A. Farwell. Common in pine country. Infrequent elsewhere.

2188a. **B. vulgaris** Greene. Detroit, O. A. Farwell.

2188b. **B. vulgaris puberula** (Wieg.) Greene. Detroit, O. A. Farwell.

GALINSOGA R. & P.

2189. **G. parviflora** Cav. Detroit, W. S. Cooper. Introduced.

HELENIUM L.

*2190. **H. autumnale** L. Sneeze-weed. River banks. Common. C. & S.

2191. **H. tenuifolium** Nutt. Fine-leaved Sneeze-weed. Port Huron, C. K. Dodge.

ACHILLEA L.

2192 **A. lanulosa** Nutt. Western Yarrow. Rochester, W. S. Cooper; Frequent in U. P., O. A. Farwell.

*2193. **A. Millefolium** L. Common Yarrow or Milfoil. Fields. Common.

2193a. **A. Ptarmica** L. Sneezewort. Mich., Gray's Manual. Rare. Th.

ANTHEMIS L.

2194. **A. arvensis** L. Corn Chamomile. Introduced. Three Rivers, C. F. Wheeler; Keweenaw Co., near Detroit, O. A. Farwell; St. Clair Co., C. K. Dodge.

*2195. **A. Cotula** DC. May-weed. Dog-Fennel. Roadsides. Common. Th.

CHRYSANTHEMUM L.

2196. **C. Balsamita tanacetoides** Boiss. Mint-Geranium. Escaped from gardens.

*2197. **C. Leucanthemum** L. Ox-eye or White Daisy. Meadows and pastures. Th.

2197a. **C. Parthenium** (L.) Pers. Keweenaw Co., O. A. Farwell.

MATRICARIA L.

2198. **M. inodora** L. Scentless Camomile. Flint, Dr. D. Clark.

TANACETUM L.

2199. **T. Huronense** Nutt. Lake Huron Tansy. Sand dunes at the head of Little Traverse Bay, and northward. Frequent; Elk Rapids, W. S. Cooper.

*2200. **T. vulgare** L. Common Tansy. Escaped from gardens. Frequent.

*2201. **T. vulgare crispum** DC. More common than the species.

ARTEMISIA L.

2202. **A. Abrotanum** L. Southernwood. Escaped in Keweenaw Co., O. A. Farwell.

2203. **A. Absinthium** L. Common Wormwood. Ionia Co.; Flint; Gratiot Co.; Keweenaw Co., O. A. Farwell. Sparingly escaped from gardens.

2104. **A. annua** L. Annual Wormwood. Detroit, O. A. Farwell; New Baltimore, J. W. Stacey.

*2205. **A. biennis** Willd. Biennial Wormwood. A roadside weed, lately introduced from the west and extending throughout the State.

2206. **A. Canadensis** Michx. Canada Wormwood. Sand dunes. Barron Lake; New Buffalo, C. F. Wheeler; Ottawa Co.; Emmet Co.; to Lake Superior. Th.

*2207. **A. caudata** Michx. Tall Wormwood. Bay Co., G. M. Bradford. Sandy fields. Ionia Co.; Montcalm Co.; S. Haven, L. H. Bailey. Infrequent. C. & S.

2208. **A. gnaphaloides** Nutt. Keweenaw Co., O. A. Farwell.

2209. **A. Ludoviciana** Nutt. Western Mugwort. Dry banks. Niles, J. T. Scoville. Univ. Herb.; Keweenaw Co., O. A. Farwell. Rare.

2210. **A. Stellariana** Bess. Port Austin. C. A. Davis; Keweenaw Co., O. A. Farwell.

2211. **A. vulgaris** L. Common Mugwort. Waste places. Infrequent.

TUSSILAGO L.

2212. **T. Farfara** L. Sault de Ste. Marie, Whitney's Cat.; Washington, Macomb Co., W. A. Brotherton.

PETASITES Gaertn.

2213. **P. palmata** (Ait.) A. Gray. Harrisville, Oscoda, Alger, and westward; Keweenaw Co., O. A. Farwell; St. Clair Co., C. K. Dodge.

ARNICA L.

2214. **A. lanceolata** Nutt. Northern Arnica. Shores of Lake Superior, Gray's Manual; Copper Harbor, Whitney's Catalogue. "It has been confused with *A. Chamissonis* of the west." Britton's Manual.

ERECHTITES Raf.

*2215. **E. hieracifolia** (L.) Raf. Fireweed. New clearings. Common northward. Th.

MESADENIA Raf. CACALIA L., in part.

2216. **M. atriplicifolia** (L.) Raf. Pale Indian Plantain. *Cacalia atriplicifolia* L. Woods. Ionia Co.; Alma; Ann Arbor; Manistee and Sturgis, F. P. Daniels; Battle Creek, W. S. Cooper; Berrien Co., H. S. Pepoon. Frequent.

2217. **M. tuberosa** (Nutt.) Britton. Tuberous Indian Plantain. *Cacalia tuberosa* Nutt. S. Mich., Wright's Cat.; three miles east of Kalamazoo, 1838, Dr. D. Houghton; Huron and Tuscola counties; Mottville, I. N. Mitchell; Bay Co., G. M. Bradford.

SYNOSMA Raf. CACALIA L., in part.

2218. **S. suaveolens** (L.) Raf. Sweet-scented Indian Plantain. *Cacalia sauveolens* L. Lodi, Miss Clark, in Winch. Cat.; Gray's Manual. Rare.

SENECIO L.

*2219. **S. aureus** L. Golden Ragwort. Squaw-weed. Very variable. Common. Th.

2220. **S. aureus gracilis** (Pursh.) Britt. A slender form of the Life-root, is frequent at Linden Park. Detroit, O. A. Farwell.

2221. **S. aureus lancelatus** Oakes. Muskegon Co., C. D. McLouth.

*2222. **S. Balsamitae** Muhl. Balsam Groundsel. *S. aureus Balsamitae* T. & G. Berrien Co., H. S. Pepoon. Northward to Keweenaw Co.

*2223. **S. discoideus** (Hook.) Britton. North of Chandler's marsh near Lansing, W. J. B.; Keweenaw Co., O. A. Farwell.

*2224. **S. obovatus** Muhl. Round-leaf Squaw-weed. *S. aureus obovatus* T. & G. More common southward.

*2225. **S. vulgaris** L. Common Groundsel., Flint; Macomb Co.; S. W. Mich. Wright's Cat.; Keweenaw Co., O. A. Farwell.

ARCTIUM L.

*2226. **A. Lappa** L. Great Burdock. Waste places. Common. Th.

2227. **A. minus** Schk. Common Burdock. *A. Lappa minus* A. Gray. Keweenaw Co., O. A. Farwell; Bay Co., G. M. Bradford.

CARDUUS L. CNICUS L. in part.

*2228. **C. altissimus** L. Tall Thistle. *Cnicus altissimus* Willd. Ionia Co.; Ann Arbor; Flint; Macomb Co.; Bay Co., G. M. Bradford. Infrequent. C. & S.

*2229. **C. arvensis** (L.) Robs. Canada Thistle. *Cnicus arvensis* Hoffm. Fields. A vile pest, introduced from Europe. Th.

2230. **C. crispus** L. Port Huron, C. K. Dodge. Introduced from Europe.

*2231. **C. discolor** (Muhl.) Nutt. Field Thistle. *Cnicus altissimus discolor* A. Gray. Meadows. Montcalm Co.; Tuscola Co.; Ann Arbor; Ionia Co.; Flint; and southward. Flowers sometimes white. Infrequent. C. & S.

2232. **C. Hillii** (Canby.) Porter. Hill's Thistle. *Cnicus Hillii* Canby. Muskegon, C. F. Wheeler; Rochester, O. A. Farwell.

*2233. **C. lanceolatus** L. Common or Bull Thistle. Roadsides and fields. Common. Th.

*2234. **C. muticus** (Mich.) Pers. Swamp Thistle. *Cnicus muticus* Pursh. Swamps, low land. Frequent. Th.

2235. **C. odoratus** (Muhl.) Porter. *C. pumilus* Nutt. S. W. Mich., Wright's Cat.; Macomb Co., Dr. Cooley; Baldwin, W. J. B.; Cheboygan Co., B. & K.

2236. **C. Pitcheri** (Torr.) Porter. Pitcher's Thistle. *Cnicus Pitcheri* Torr. Shores of the Great Lakes; sand dunes.

2237. **C. spinosissimus** Walt. Yellow Thistle. *Cnicus horridus* Pursh. N. shore Lake Superior, Agassiz; Grand Detour, T. C. Porter.

2238. **C. undulatus** Nult. Wavy-leaved Thistle. *Cnicus undulatus* A. Gray. Islands of Lakes Huron and Michigan, A. Gray; Drummond's I., Winch. Cat. N. & U. P.

MARIANA Hill. SILYBUM Gaertn.

*2239. **M. Mariana** (L.) Hill. Milk Thistle. *Silybum Marianum* Gaertn. Occasional.

ONOPORDON L.

2240. **O. Acanthium** L. Cotton or Scotch Thistle. Grand Rapids; Detroit, O. A. Farwell. Rare.

CENTAUREA L.

2241. **C. Cyanus** L. Blue-bottle. Escaped from gardens.

2242. **C. nigra** L. Black Knapweed. Centaury. Bay City, G. M. Bradford.

ECHINOPSIS.

2243. **E. sphaerocephalus** L. Well established at Three Rivers, C. F. Wheeler. Grand Rapids, H. C. Skeels. Introduced from Europe as a plant for bees.

INDEX.

THE TOPOGRAPHIC SURVEY OF MICHIGAN.*

BY ISRAEL C. RUSSELL, PRESIDENT OF THE MICHIGAN ACADEMY OF SCIENCE FOR 1902-1903.

The excellence of the maps a nation or a state produces of its own territory is an index of its rank in the scale of civilization. The absence of such maps in the case of nations or states not too young to have had time for extensive internal improvement, is equally symbolical of lack of energy and of retarded intellectual and commercial growth.

The more enlightened nations of Europe at the present time are in advance of all other governments in the completeness and accuracy with which their respective domains have been surveyed and mapped. Germany, France and England, in particular, among the larger land owners of the Old World, possess excellent maps of the regions within their respective boundaries. The nations referred to have not only surveyed their possessions once, but in several conspicuous instances, no sooner was a map of a given degree of excellence and an advance on all previous attempts in the same direction, obtained, than still more accurate surveys and still larger-scale maps have been demanded for military and industrial purposes, and re-surveys, and the production of still more exact and more detailed maps undertaken. This earnest and constantly increasing desire manifested by the nations of Europe, for accurate information concerning the lands within their immediate borders, has also in many instances, but most conspicuously in the case of the English in India, been extended to their insular possessions. While admirable maps are available of nearly all the countries of Europe, similar maps embracing any considerable areas in America were almost unknown up to the time of the organization of the United States Geological Survey in 1879. Even at the present time creditable maps of the entire area of only four individual states can be had, and in Michigan less topographic work has been done than in any other state, with the exception of Florida and Minnesota. There are maps and maps, however, and in planning a survey of a state it is necessary to decide as to what kinds of maps are needed and to reckon cost.

WHAT IS A MAP?

The maps we most usually see, in atlases, on the walls of schoolrooms, in works of travel and histories, etc., are representations on a plane surface of political boundaries, the positions of towns, and the outlines of such natural features as the shores of oceans and lakes, the generalized courses of streams, etc. The positions of these objects are indicated with more or less accuracy by means of two co-ordinates, namely latitude and longitude. The various methods of representing portions or the whole of the curved surface of the earth on a plane, or of projection, need not be considered at this time. The characteristic feature of the maps referred to, is that by means of but two co-ordinates, only the relative horizontal positions of objects can be represented and

*Revised December, 1904.

not relief of surface. Such maps are mere diagrams in two dimensions, and take no account of the heights and shapes of mountains, the breadths and depths of valleys, etc., or, in short, of any element of the earth's surface rising above or depressed below an assumed plane. They are not only devoid of expression, but to a great extent meaningless and even misleading. When the pupil steps outside the schoolroom he finds the region about him not a featureless plain, as his maps have taught him, but diversified in relief in many ways.

The maps of Europe and the more modern maps published in America, to which reference has been made, in addition to representing the relative positions of objects on the earth's surface, indicate with an equal degree of accuracy the heights and shapes of mountains and hills, the forms of valleys and the slopes of their enclosing uplands. In many instances, the shapes of lake basins below the water's surface and of the ocean's bottom are also quantitatively shown. In brief, such maps represent portions of the earth's surface in three dimensions, by means of three co-ordinates, namely, latitude, longitude and height above or depth below sea level.

While *map* is a word generic in its significance and used to include many species, as they may be termed, the particular species to which attention is here invited, is the one on which relief of the surface is represented, or the topographic map. On topographic maps there are also presented in most instances, all of the data that can be shown on a diagram, as, for example, political boundaries, roads, shore-lines, etc., or the relative geographic positions of objects when reduced to a horizontal plane. The significance of the word *topographic* in the above connection is principally in reference to relief of surface. The term has also acquired, by common consent, another significance, namely *accuracy*. Maps on which attempts are made to show relief, are usually of such a degree of excellence that accuracy in their construction has become a chief reason for their existence.

The demand for precision in the surveys on which topographic maps are based, has become so rigid and the degree of skill required to present it in final dress so great, that topographic mapping has developed into a distinct branch of applied science, differing from other methods of surveying.

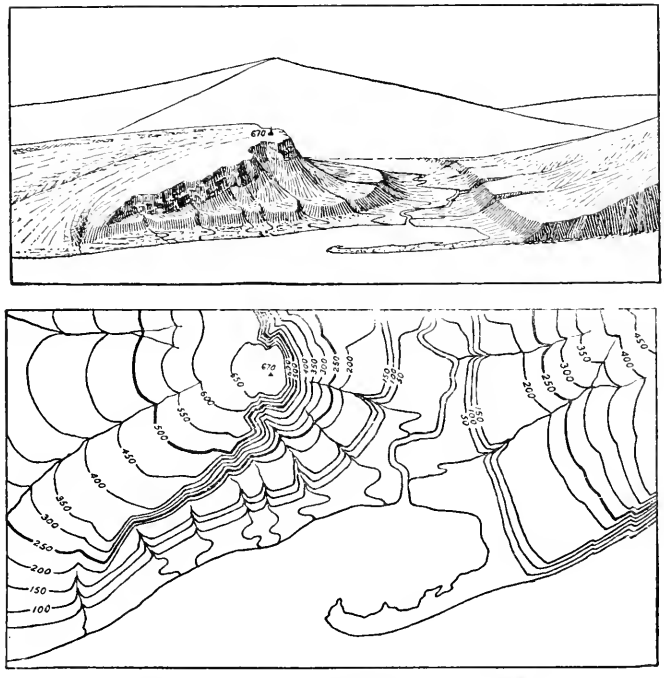
The successful topographer is not only a surveyor but to no small extent an artist. In his finished work, if well done, there exists, side by side, nay in the same line, the accuracy of the geodesist and the expression of the landscape painter. A topographic map is a picture of a given surface in which every part is precisely located in reference to three co-ordinates. It is a representation, we will say, of a mountain from every direction in which it may be seen. From such a map not only is a bird's-eye view attainable of the region delineated, but from it one can read distances, heights, depressions, and the slopes or gradients of the surfaces of uplands and valleys. Nor is all told that may be read on such a map, when the bare representation of the existing land surface is interpreted. With an accurate topographic map of an extensive region, such as a mountain range, or a river system, in hand, the geographer is enabled to read between the lines, as it were, much of the geographic history of the area represented and to predict with a high degree of confidence the changes that are to come. In skilled hands, an accurate topographic map becomes an instrument of research, and one that is indis-

pensable to those who seek to learn the laws governing our physical environment.

CONTOUR TOPOGRAPHIC MAPS.

In searching for methods by means of which the relief of any region may be represented on a plane surface, resort has been made to various devices, such as brush shading, shading by means of short inclined lines or *hachures*, continuous lines drawn through points having the same elevation or *contours*, etc. Of these various methods, the last mentioned, namely, the use of contour lines, has by long experience and especially when the question of expense is considered, been found the most satisfactory by the majority of geographers. The contour topographic map is without question the map of the future.

By means of lines drawn through all points represented on a map, having the same elevation or the same depression in reference to the assumed datum plane, the shape of the surface in question may be accurately portrayed. Such lines are termed contours, and a map on which relief is shown by this method, becomes a contour topographic map. Contour lines are few or many, according to the horizontal scale of a map, and the degree of completeness with which it is practicable to indicate the relief of the surface represented. The vertical distance between two adjacent contour lines, or the *contour interval*, may be any measure, as for example, ten, or one hundred feet. By this method not only can the elevation of any point included on a map which is crossed by a contour



Ideal Sketch and Corresponding Contour Map.

line, be read at a glance, but the elevation of any point between two adjacent lines may be judged with a close approximation to accuracy.

In order to make the significance of contour lines more clearly understood, a picture is here presented through the courtesy of the U. S. Geological Survey, of a bit of coast, with a terraced valley between two hills on the adjacent land; and beneath it is a contour map of the same locality, on which the contour interval is 50 feet.

If one imagines the land shown in the sketch, to be intersected by several horizontal planes, fifty feet apart, the lines produced by the intersection of such planes with the surface of the land, would be contour lines. These lines, if viewed in all parts from directly above, would show the shape of the surface of the land. From the illustration it will be seen that a contour map is a horizontal projection of contour lines; that is, each contour line is dropped, as it were, to the plane in which the lowest in the series is situated, which is usually the horizon of the ocean's surface, and the figures placed upon it show the height of its previous position.

By comparing the above sketch with the map of the region it represents, it will be seen that where slopes are steep, the contour lines are near together, and where the slopes are gentle the lines are wider apart; the vertical distance between any two adjacent contours being always the same. In making surveys for contour maps, actual lines are not marked on the land, but the topographer locates on his field sheet a number of points having the same elevation, and while occupying these stations, sketches the course of the lines connecting them. It is to the accuracy of this freehand sketching controlled by a number of definitely located points, that the expression and much of the value of the finished map is due.

It is by means of contour topographic maps of the nature just described, usually drawn to a horizontal scale of about one mile to one inch, or $\frac{1}{62500}$ of nature, but frequently of still larger scale, that most enlightened nations, as previously stated, are striving to represent their respective territories. No doubt the reader will enquire: Why the widespread demand for such maps among the people of the most progressive countries?

USES OF CONTOUR TOPOGRAPHIC MAPS.

The advantages of contour topographic maps over the more familiar diagrams of boundaries, roads, streams, etc., are due to the fact, as already stated, that they are representations of a given area in three instead of two dimensions. From them vertical as well as horizontal distances can be measured. The value of the vertical element or the relief, is very great, especially when combined as it is on all creditable contour maps, with the results of accurate linear surveys.

To attempt to explain all the aids to industrial, commercial and intellectual development, furnished by contour topographic maps, would require more space than I have at command; and besides, on account of their faithfulness to nature, such maps create for themselves new and previous to their appearance, unsuggested uses. In many branches of nature study, they may be likened to the application of a previously unemployed agency, such as the use of steam, electricity and compressed air in the mechanical arts. In the hands of engineers, geologists, foresters, biologists, farmers, statesmen, and to teachers and students in

many branches of knowledge they offer not only direct aid, but suggest new methods and untrodden paths of research.

To Engineers: Contour topographic maps supply such data to engineers as is obtained frequently at great expense, by means of preliminary surveys, such, for example, as are usually made for the trial location of railroads, canals, irrigation systems, reservoir sites, aqueducts, etc.: or in brief, for all engineering works in connection with which the relief of the surface of the earth throughout a considerable and frequently great extent of country needs to be known before the best locations for the far more expensive detailed surveys can be chosen.

In reference to the direct money value to engineers, and to the companies, corporations, etc., employing them, of a contour topographic map of Michigan, for example, it may be shown that with such a map in hand, a railroad could be projected across the State, grades computed, cuts and fills measured and approximate cost of construction ascertained without expense for trial surveys. More than this, not only could one such line be studied but all possible routes between any two localities within the State, discovered and scrutinized and from a comparison of them the most desirable location chosen, for both engineering and commercial reasons. All of this can be done with the aid of a creditable contour topographic map, without the expenditure of a single dollar for surveys. What has just been stated is equally true of ship and drainage canals, trolley lines, telegraph and telephone lines, water supply and sewer systems, or, in short, all geographically extended undertakings that states, municipalities, companies, etc., commonly engage in.

In what has just been stated, reference is made to savings that may be secured by using a topographic map in place of preliminary surveys, but as may be illustrated by many definite examples, contour topographic maps are of service in suggesting ways in which railroads, etc., already constructed or for which final, detailed surveys have been made, can be shortened or otherwise improved.

In proof of the above, perhaps seemingly too sanguine assertions, a few from many specific examples that are available may be of interest:

In the summer of 1901, the Wabash Railroad Company was locating a railroad line from the Ohio river across Jefferson and Harrison counties, Ohio, to connect with the Wheeling and Lake Erie railroad; and during the same summer a contour topographic map of the region referred to was being constructed by the United States Geological Survey. The railroad surveys were completed, a location chosen, grades, cuts, etc., including a tunnel, decided on, and contracts for construction entered into; when advance copies of the topographic map that was being made came to hand. From an inspection of the map the possibility of a shorter route, with equally favorable grades, and without the necessity of a tunnel, was discovered. The new location was at once adopted, and resulted in the saving of $80,000.00 in construction. This correction of a detailed railroad survey, with the aid of a contour topographic map, was made possible by a study of the map itself, and without expense.

Again, at Waterbury, Connecticut, after two sources of water supply for the city had been surveyed at an expense of $10,000.00, a contour topographic map of the region about the city, made by the United States Geological Survey, was received by the engineer in charge, Mr. R. A. Cairns, and from an inspection of it, a better source from which to obtain water was discovered, and finally adopted. Not only was the new site

and the one now supplying the city of Waterbury, suggested by the study of the map referred to, but not one cent was expended for preliminary surveys.

Much additional testimony in the above connection might be presented, but a single example must suffice:

The Chief Engineer, L. A. Hyer, of the Washington and Chesapeake Railway Company, in a letter expressing his appreciation of the topographic work done by the United States Geographical Survey, says:

"I used your contour maps in the location of this road. Had to rerun but very little of the line and reduced the number of curves to six from 107, or saving in all 3,266° of curvature, shortening the line 4.7 miles over a line previously located by me without the aid of these maps."

In a memorial advocating a topographic survey of Michigan, presented to the Legislature in 1897, by the Michigan Engineering Society, the reasons for demanding such a survey are tersely stated and I cannot do better than to quote them in part, in proof of the value of topographic maps to engineers:

"No topographic map of the State of Michigan, and, in fact, no map of the State worthy of the name, now exists or can be compiled from existing surveys.

"Such a map cannot be constructed except as the result of an accurate topographic survey.

"Much money is wasted every year in re-surveys owing to the lack of a general compilation of past surveys in a convenient map.

"The increase and extension of systems of land drainage and irrigation imperatively demand a contour topographic map by which alone they can be planned in a systematic and efficient manner.

"The construction of systems of sewerage for our growing towns would be greatly aided by topographic maps.

"Topographic maps are an absolute necessity before intelligent judgment can be given between various projects of water supply for towns, and for this use alone they might well be worth all that they would cost.

"They are a prerequisite for the scientific study of our water powers, and of those areas which should be preserved for forest culture at the head waters of our streams in order to prevent the depletion of these water powers.

"They would aid immensely in securing the best locations for railroads, both steam and particularly the electric roads which will eventually gridiron the State, and would save large sums of money which would otherwise be spent for preliminary surveys or useless construction, the interest on which the people of Michigan would have to pay.

"They would be of great value to both the sellers and purchasers of land by showing the character of the surface, whether level or hilly, wet or dry, timbered or cleared, well or poorly watered.

"The establishment of a true meridian line in every county, which is part of the proposed work, would go far toward diminishing the litigation which arises out of erroneous surveys due to variation of the magnetic needle; and the establishment of permanent bench marks in every township, referred to a common datum, would be of great value to land owners in planning extensive systems of drainage."

To Geologists: I make bold to say, and without fear of challenge from competent judges, that a high grade topographic map, on such a scale as the nature of the region studied may dictate, is indispensable for

accurate geologic work, and for the adequate presentation of the results of geologic surveys. To sustain this statement I might present detailed statistics of the large sums that have been applied from appropriations for geologic surveys, for purely topographic work, both in European countries, and by our Federal and some of our State geologic surveys. Several states, however, including Michigan, have ignored the fact that topographic should precede geologic surveys, or have been unable to bear the expense of preparing topographic maps for the use of their geologists, but, instead, have required them to do what they could without maps, or piece together such diagram-maps as were available. In all such instances the best geologic work that could be done was in large part provisional, and in most cases re-surveys became imperative. By this illogical method the preparation of final reports has been long delayed, and much valuable time and large sums of money wasted.

The urgent demand of a topographic survey of Michigan in aid of the geologic survey that has been in progress with various interruptions since 1837, is well expressed in the following extract from a letter by L. L. Hubbard, State Geologist, under date of May 20, 1895:

"It gives me great pleasure to express my appreciation of the efforts made by the Michigan Academy of Science to procure the enactment of legislation to authorize the construction of a topographic map of the State. The absence of such a map is a constant regret to the members of the Geological Survey, not only in their office work, but particularly in the field. We now have to use copies of township plats made fifty years ago, when apparently no great effort was made, or, under the conditions then existing, could be made to delineate the topography with any approach to detail. To improve these maps and to locate our specimens we often have to meander roads at a great loss of time, and we never can be certain of the accuracy of our barometrical observations, which in themselves take much time unless, we employ an extra man to make simultaneous observations at some point of known altitude. You can appreciate the difficulty of correlating beds that outcrop at different horizons, when the difference of altitude is unknown.

"Indeed, if we had a good topographic map, I am sure we could save a great deal of money and do more work in a given time than we do now. We should also know much better where our work could be done to the greatest advantage."

To Foresters: In the forest culture of Germany and other European countries, topographic maps are in constant use. The setting aside of great forest reserves in the United States was followed immediately by the preparation of topographic maps of their several areas as an initial step to the study of forest conditions, the prevention of forest fires, and the ultimate harvesting of a forest crop. The necessity is thus indicated for accurate topographic maps in the scientific study of the forests of Michigan recently begun, and which promises such great returns, especially in the way of re-foresting our depleted pine-lands.

In reference to the value to our forestry survey, and through it to every person living in Michigan, of a topographic map of the State, in order to regain in part our squandered inheritance, I am permitted to quote the following statements by C. A. Davis, Instructor in Forestry in the University of Michigan, who has made a preliminary study of the forest reserves of the State:

"A topographic survey and resulting map, of Michigan, is of funda-

mental importance and a necessary preliminary step, if we are to have intelligent and well planned forestry work done in the State.

"The maps now in existence, even those of long settled parts of the State, are, with the exception of those of comparatively small areas recently produced by the United States Geological Survey, very inaccurate, give no indications of the surface conditions, and none of the data demanded for even the intelligent location of a farm, and to the forester are of no use except for the most superficial study of the complex problems with which he has to deal. These facts have been borne in upon me in my own efforts at field-work in forestry, and have caused me great annoyance and waste of time, for in each area studied I have had to construct a map as I proceeded with my work, at great expense of time and at no small cost. The contrast of having a well prepared topographic map was impressed upon my mind when the advance reproductions of the topographic map of the quadrangle including Ann Arbor, became available for use. With these in hand it is possible to do at least four times the work per day as formerly, for the reason that the details of the topography can be read from them at a glance and notes upon soil distribution, vegetation, etc., can be indicated on them with great exactness and very rapidly.

"Should the topographic survey of Michigan, recently begun, be extended over the entire State, as eventually it must be, the work of arriving at a final solution of the forestry problems, now unnecessarily complicated, owing to the absence of a reliable topographic map, would be greatly simplified."

To Biologists: Nearly every civilized country in the world has published the results of systematic examinations of the plants and animals within its boundaries. Such a biologic survey, or study of both the flora and fauna of the United States, is now being actively conducted by the Department of Agriculture at Washington, and either in affiliation with that department or working independently, several of the states of the Union are carrying on similar surveys, or have done so in the past. The immediate economic aim of national and state biologic surveys, is to learn how plants and animals may be made more useful to man; to ascertain which are our friends and which our enemies among the living hosts surrounding us; to discover the fungi, parasites, bacteria, bacilli, germs, or by whatever name the unseen legions may be designated, which cause blights among plants and disease and death of the lower animals and of man. The pioneer work in this great field has been done, but the true biologic study is still in its infancy. As an example of what may be accomplished by such surveys, reference need only be made to the work of Major Reed in banishing yellow fever from Cuba. Similar beneficial results have been reached in other directions, and many more safeguards to life and means of advancing the material welfare of man, it may be stated with entire confidence, will be discovered in the future.

In the study of the vast and but partially explored domain of life, one of the first steps is to make a concise record of carefully observed facts. All life, it is safe to say, is molded and controlled by its environment. The mountains are clothed with plants in orderly ranks from their bases up to the lower limit of perpetual snow, and even above that limit lives the blood-red *Protococcus*. In each zone of plant life there are certain animals peculiar to it, and, these again, in many instances, are hosts for other plants and animals. This definite distribution of living forms in

reference to differences in elevation, in exposure to light, in range of temperature, in humidity and still other conditions, applies to hillsides as well as mountain slopes. It is modified, too, by differences in latitude, and is dependent in a conspicuous way on position with reference to seas, lakes, and streams. In brief, a biologic survey is concerned primarily with the distribution of plants and animals. Commonly such distribution is termed geographic, but from what has just been stated, it is evidently topographic as well. In the ideal biologic survey, the distribution of each species of plant and animal with reference to both geographic position and elevation, needs to be accurately known. To record such data, and discover the causes which control distribution, or, in other words, to learn the conditions on which life depends, and hence be able to modify it or strive to exterminate noxious forms, an accurate map showing the relief of the country studied, the distribution of water bodies, the inclination of land surface, etc., is a primary requisite. Without such a map a critical biologic survey of any extensive region is impossible. Delay in making such surveys means continued exposure to unseen enemies, and neglect of opportunities to utilize benign agencies which are at our command.

A biologic survey of Michigan was embraced in the plans of Douglass Houghton, in 1837, for the study of the resources of the State, but not carried into effect. Up to the present day no adequate study of the native plants and animals of Michigan, or of the species introduced and their influence, whether harmful or beneficial, has been made. This matter is now commanding attention, and the first step in the desired direction, as all biologists will agree, is the preparation of an accurate topographic map of our broad domain.

One phase of biologic study relates to the diseases of men. In Michigan this subject is now in part, entrusted to the State Board of Health. Among the aims of that organization is the discovery of the ways in which contagious diseases are disseminated, the influences of drainage on health, the dangers resulting from the pollution of streams, the geographic distribution of diseases, etc. In these and other related subjects pertaining to medicine and hygiene, a knowledge of geographic conditions is plainly of fundamental importance. This necessary preliminary information, however, cannot be had by the guardians of health in Michigan, until a topographic map of the State is available. With such a map in hand, the facts now known concerning the relation of diseases to environment could be clearly shown, and much aid afforded in the search for still hidden causes of bodily ailments.

To Farmers: The possibilities of agriculture are determined mainly by soil and climatic conditions. The better these are known and the better this knowledge is applied, the more successful the results. To furnish this knowledge, the Agricultural Department in Washington issues thick volumes filled with the results of soil survey, and accompanied by portfolios of maps on which soil conditions are indicated; and the United States Weather Bureau each year, each month and each day, sends out maps on which climatic and weather conditions are graphically recorded. Both in the gathering of these important data and in their distribution maps are essential, and the better the maps, the better will be the results. In the study of soil conditions more definitely perhaps than in related branches of research, is the influence of relief and, depending on the relief, of drainage and distribution of soil-moisture, to be taken

into account. The high aim entertained in this connection by both students of agriculture and scientific agriculturists, however, can never be attained without the assistance of accurate topographic maps in planning investigations and exhibiting results.

The ice sheets which once completely covered Michigan, on retreating left an irregular surface. In places the ground is high, well drained and admirably adapted to various kinds of farming. Large areas, however, as in Saginaw valley, and many other sections of the State, are low and swampy. The drainage of these areas is in progress, but the task has scarcely more than been begun. One of the great benefits of a topographic map would be to show how these now useless areas may be reclaimed and converted into agricultural land, as has been done in the case of some of our celery and truck farms, or the marl and peat they contain utilized for making Portland cement, and for fuel.

Our rural communities are interested in and will, without doubt, reap priceless advantages from improved roads, free mail delivery, segregation of schools, etc. In all of these directions, an accurate knowledge of the geography of the State is necessary for those who control legislation, and devise far-reaching plans for lessening the burdens of isolated communities.

To Statesmen: The business affairs of the State of Michigan are intrusted to a governor, legislators and other officers. The duties imposed upon these representatives of the people necessitate an extensive knowledge of the geography of the State, in order that they may intelligently carry out the laws already enacted, and judge wisely as to the merits of the countless and exceedingly diverse measures of public concern which arise. At each session of the legislature numerous franchises, charters, etc., are asked for, pertaining to the building of railroads, trolley lines, telegraph and telephone lines, municipal improvements, enlargement of cities, incorporation of towns, location of factories, etc., each of which demands a critical and frequently extensive knowledge of geographic conditions in order that the full import of the proposed enterprises may be understood and the vested rights of parties not directly participating therein, properly guarded.

In several memorials that have been published, relating to the topographic survey of Massachusetts, New York, and other states, much stress is placed on the value of topographic maps in relation to taxation and the sale of land. These needs are not so urgent in Michigan as in several of the older states, for the reason that in this State surveys for the parceling and sale of land have already been made. The maps resulting from these surveys, however, are of but little value in showing the character of the land, and hence are inadequate as a basis for equalizing assessments.

The usefulness of topographic maps to legislators, is also apparent from the facts already mentioned in reference to special surveys that are being carried on at State expense, in order that they may judge intelligently as to the needs of such undertakings and of the efficiency with which they are conducted.

Such a survey as is under consideration, furnishes the best of base maps for the graphic representation of facts relating to distribution of population, industries, products or other statistical information, for which there is a constant demand by statesmen, newspaper editors, and, in fact, by all the more enlightened citizens of a republic.

To Students and Teachers: Aside from all direct money returns and money savings which a topographic map insures, such a map of a state is of incalculable value to its children whether of tender or mature years. The conspicuous advances recently made in the development of physical geography has opened an almost boundless region of fascinating study which brings the student in direct communication with nature. One of the greatest attractions of what has justly been termed the new geography, is the recognition of the fact that the earth is not a finished work, but the molding and sculpturing, and even the coloring and decoration of its surface are still in progress. One of the great tasks of the geographer is to discover how the many features of the land, such as mountains, valleys, canyons, fruitful vales and upland pastures, came into existence. The key to the situation was discovered when the "everlasting hills" were found to be transient forms, and *terra firma* never at rest. The upheaval of land above the sea and its sculpturing into diverse forms with marvelously intricate details, was begun in the remote past, is still in progress and, so far as can be judged, will continue into the distant future. To understand what changes the earth's surface has undergone, and predict although with reserve, what mutations are to follow, the geographer studies the changes now in progress and from them seeks to discover wide-reaching laws.

Those who question nature and listen for her answers, go forth into the fields, follow the streams, traverse the pathless forest or stand alone on the silent and awe-inspiring mountains. To view natural processes at work in shaping and re-shaping the earth's surface is one of the greatest charms of such excursions. Travelers who have wandered farther in this quest than those who sought the Holy Grail, have returned to the vale in which they passed their youthful days, only to find that much for which they looked could there have been seen while they were yet young, had they been taught to see, or rather to observe. The sculpturing of the most magnificent mountain, is reproduced in minature in many a hill; the essential features of the most profound canyon have their counterpart in the trench cut by the wayside rill. The tools with which nature works are in each case the same, it is only the size of the blocks that are being sculptured and the rate at which the task is being carried on, that differ. For these and kindred reasons it may be shown that the study of geography should begin at home.

To understand the work of even a moderate sized river, however, and to learn how, in one part of its course, erosion and canyon cutting are in progress, and how debris is being taken into suspension, and carried to where it can be spread out in flood plains, alluvial cones, deltas, etc., making new and richer lands, can not be fully shown and quantitative measures made, rate of degradation or upbuilding, etc., ascertained, without the aid of accurate maps. But few people can retain in mind the relations of the various details to be observed in the relief of even a square mile of a moderately rough portion of the earth's surface. The task of visualizing or of picturing before the mind's eye the relief and interrelations of the surface features of a county or a state, surpasses the ability of even the best trained geographer, without the aid of maps which reproduce these features in miniature. The aim of these truisms is simply to show that a map, and especially a contour topographic map, drawn accurately with reference to both horizontal and vertical distances, is the

chief tool with which the geographer carries on his researches, and affords the best means of presenting his results.

The beginner in geography should study a restricted region with the aid of a good map, and also study the map with the aid of an accurate knowledge of the area it represents. In this way, as in no other, is the eye and the mind trained to interpret natures picture-writings, and at the same time acquire skill in reading the draftsman's representations of them. While the interpretation of nature is the chief aim in such field studies, an essential means to that end is the ability to read topographic maps. In this connection, it is not requiring too much when teachers are asked to instruct their pupils in the art of reading topographic maps as well as the printed page. This can be done to the greatest advantage by means of local or home maps.

One of the most important principles in the teaching of the new geography, is that geographical studies should begin at home, and widen in constantly enlarging circles until, as an ultimate aim, the meaning of the surface features of the entire earth is grasped. As has been said by one of our leading teachers of geography: Inattention to home surroundings during school years may be followed by geographic blindness throughout life.

The tens of thousands of boys and girls in the schools of Michigan cannot make a proper beginning in geography until a topographic map of the land surface with which they are individually familiar, is available for their use. The study of a topographic map of the region about every school should be required of each of its inmates. In each schoolhouse, accurate topographic maps of the town, county and state in which it is situated, should have precedence over all other maps. These important aids to education can be had in Michigan at an expense of a very few cents, when once a topographic map of the State, such as has just been begun, is available.

While the important economic uses of topographic maps make but little appeal to me personally, except in a general way, as a citizen of a great and prosperous State, the educational value of such maps does come home to me with perhaps undue force. With an accurate map of Michigan available, my task of imparting to my classes in the University a knowledge of the broader principles of geology and geography, would be greatly lessened. In urging an early completion of the topographic map of this State, I am confident I have the hearty support of every teacher in it.

Much might be said in reference to the multiple advantages to be reaped from such a survey and map as is here advocated, did space permit, but other aspects of the work demand attention. Before turning to another phase of this discussion, however, I wish to direct attention to one other fact,—although such a course seems unnecessary, so plain is the conclusion referred to, but it is this: once a topographic map of Michigan is made, it will descend as a rich legacy to all future generations of engineers, geologists, farmers, manufacturers, teachers, students, legislators, etc., of our growing State, and its influence for good on intellectual, industrial and commercial development be far-reaching and cumulative.

THE TOPOGRAPHIC SURVEY OF THE UNITED STATES.

At the beginning of the work of the United States Geological Survey, in 1879, there was no map available of the region to be studied, which would serve as a basis for the geologic map ordered by Congress. To meet this difficulty, a topographic division of the survey was promptly organized, and slowly drilled until it became fully as efficient as any other similar corps in the world. During the past twenty-three years, the arduous task of making a contour topographic map of the United States has been carried steadily forward, and greater and greater excellence in the finished maps secured, as a result of increasing experience and more and more exacting demands. The maps produced during the past decade are worthy of critical comparison with the best maps of like character on the same scale, and produced at similar cost, made anywhere in the world.

The plan adopted by the United States Geological Survey in mapping our country, is to divide it into quadrangles, representing what is termed one square degree. That is, the standard sheets include one degree of latitude and one of longitude. The area shown on each sheet varies in accord with its geographic position, but in general embraces about 900 square miles. These maps are drawn to scale of about two miles to one linear inch, or $\frac{1}{125000}$ of nature, and relief is shown by contour lines, with intervals ranging from 100 to 20 feet, according to the roughness of the land. When circumstances render a larger scale desirable, however, the quadrangle is made to include one-quarter of a square degree, and the scale is enlarged to one mile to one inch, with contour intervals of 20 feet, or less. Special maps are also made on still larger scale for mining, municipal and other purposes. On these maps the lakes, streams, etc., or the hydrography, are represented in blue; the contour lines in brown, and the cities, roads, houses, etc., or what is termed "culture," in black; the lettering is also in black.

Contour topographic maps of the character briefly described above, have been made by the United States Geological Survey when the demand for them as base maps for geologic work was greatest. The maps now available embrace a portion of every state and territory in the Union, and although to a great extent the published sheets are disconnected and independent, each one has its allotted place in the contemplated map. Up to the present time about one-third of the area of the United States has been surveyed, and for the completion of the task at the rate it has been progressing during the past decade, at least fifty years will be required.

CO-OPERATION BETWEEN THE FEDERAL AND STATE SURVEYS.

The topographic work of the United States Geological Survey, as stated above, is primarily to furnish a base for a geologic map, and has been carried on where the demand for such maps, particularly of mining regions, is most urgent. For this reason the work has been distributed without reference to state boundaries. Several states, however, recognizing the value of the topographic maps the Federal survey is making, and cognizant of the fact, also, that when once topographic maps are available, detailed geologic and forestry surveys, conducted by the general government usually follow, have been anxious that topographic maps should be made of their entire areas. With this aim in view, several

states have arranged to co-operate with the United States Geological Survey in making complete surveys of their respective territories.

The basis for such co-operation is for each party to the agreement to pay one-half of the expenses of the actual survey and for office work in preparing maps for publication. The work to be done by or under the direction of the Federal Survey. In addition to defraying one-half of the field expense, the Federal Survey engraves and prints the finished maps. The edition thus produced, however, is the property of the United States, but the State may order as many copies of the maps as it wishes, for the price of press-work and paper, or, as is usually done, have electrotypes made of the original plates and print its own edition.

The expense to co-operating states for copies of the final map-plates, is thus considerably less than their total cost, and not over one-fourth what it would cost a state to organize an independent survey and do the same work. The reason why it would be much more expensive for a state to survey and map its own territory than it would cost the Federal Survey to do the same work, is because the Federal Survey is completely organized, has trained topographers in its corps, and is already provided with instruments, etc.

The states which have taken advantage of the generous offer of the United States Geological Survey referred to above, and now have maps of their respective territories completed or under way, together with the expenditures in each instance, may be seen from the following table:

CO-OPERATIVE TOPOGRAPHIC SURVEYS IN VARIOUS STATES.

State.	Area in square miles.	Area mapped in square miles.	Total cost to June 1901.	Appropriated by State to June, 1901.	Appropriated by State for 1902.	Appropriated by State for 1903.
Massachusetts	8,315	All	$167,845	$40,000		
Connecticut	4,990	All	48,555	25,000		
Rhode Island	1,250	All	9,732	5,000		
New Jersey	7,815	All	54,744	19,670		
Pennsylvania	45,215	10,785	130,260	38,000	$15,000	
New York	49,170	25,802	303,930	151,000	20,000	
Maine	33,040	4,767	38,985	10,000	2,500	
Maryland	12,210	10,307	57,250	17,000	6,000	
Ohio	42,050	1,864	12,000	25,000	20,000	$30,000
North Carolina	52,250	12,252	.....	20,000	5,000	
West Virginia	24,780	17,227	.....	30,000	5,000	
Michigan	58,915	.....	.....	.....	2,000	
Alabama	52,250	.....	.....	3,000		
Mississippi	46,810	.....	.....	.....	1,000	
Texas	265,760	.....	.....	.....	2,500	

As is indicated in the above table, four states have maps of their respective areas complete, and eleven other states have declared their intention, as it were, to supply their citizens with the aid to both commercial and educational development which such maps afford.

TOPOGRAPHIC SURVEYS BY THE UNITED STATES GEOLOGICAL SURVEY IN MICHIGAN.

In the iron districts of the Northern Peninsula of Michigan, large-scale contour topographic maps have been made by the United States Geological Survey of areas aggregating nearly 2,000 square miles. This

important work was done in order to furnish satisfactory base-maps for use in making detailed studies, particularly of the geology of the iron bearing rocks. Very complete and accurate reports on these investigations have been published, accompanied by both topographic and geologic maps without cost to the State of Michigan.*

CO-OPERATIVE TOPOGRAPHIC SURVEYS IN MICHIGAN.

In 1901 and 1902 a topographic survey was made by the United States Geological Survey, in co-operation with the Geological Survey of Michigan, of an area of 910 square miles, in the Southern Peninsula of Michigan, and including the region about Ann Arbor, Ypsilanti, etc. The work was done under the immediate direction of Mr. Robert Muldrow, to whose skill and efficiency much credit is due from the citizens of this State. The map on which the results of this work are shown, is termed a thirty-minute sheet, that is, it includes one-half a degree of latitude and one-half a degree of longitude, is drawn to scale of about two miles to one inch or $\frac{1}{125000}$ of nature, with 20-foot contour intervals. It is to be printed in three colors, uniform with the other sheet of the "Topographic Atlas of the United States," and designed at the Ann Arbor quadrangle. In addition to the map now in hand, bench-marks, giving the precise elevation above the sea, have been placed at many convenient localities throughout the region it represents; these will be of assistance in making local detailed surveys for various purposes, and serve to unite in one system all surveys based on them.

The expense for field work for the map just described, was $6,482.47, and for office work in preparing the data for publication, about $400.00; making the total cost approximately $6,880.00. Of this sum $2,000.00 was paid from the appropriation made by the State Legislature, for the Geological Survey of Michigan, and the remainder by the United States Geological Survey. The total cost per square mile was about $7.55, or a trifle over one cent per acre. The State of Michigan is entitled to have a reproduction made of the original copper plate from which the map is to be printed, if it so desires, or as is the rule with all publications issued by the Federal government, may order as many prints from the original plate as is required, at the cost of press work and paper. Individual copies of the Ann Arbor quadrangle will be sold by the United States Geological Survey at five cents each; and may be obtained in numbers exceeding 100 for two cents per sheet.

The map now completed of the region about Ann Arbor and Ypsilanti, is an admirable piece of cartographic work, and one for which the citizens of that region should be very grateful. Its accuracy and value have been recognized by all competent judges who have examined it. In this connection I am permitted to make public the following testimonials:

M. S. W. Jefferson, Professor of Geography in the Normal College at Ypsilanti, writes:

"The map of the Ann Arbor quadrangle is to the students of geog-

* The Marquette iron-bearing district of Michigan, with atlas, by Charles Richard Van Hise and William Shirley Bayley, including a chapter on the Republic Trough by Henry Lloyd Smith, Washington, D. C., Government Printing Office. 1897, quarto, pages I-XXVI, 1-608, and folio atlas of 39 sheets. Price $5.75.

Geological Atlas of the United States, Menominee special folio, Michigan. Folio No. 62, by C. R. Van Hise and W. S. Bayley. Size 18 by 21 inches, 13 pages of text; one topographic and one geologic map. Price 25 cents.

raphy in the Michigan Normal College, what a natural history museum is to students of biology. On it are represented a large variety of topographic forms such as morainal hills, stream-cut valleys, abandoned lake beaches, lake plains, etc., which our students quickly learn to recognize and to enquire as to the history and meaning of. The map on account of its home relations, furnishes an aid in teaching such as no map of a distant region, however instructive, can supply."

Mr. Frank Leverett, of the United States Geological Survey, who for several years has been engaged in the detailed investigation of the surface geology of the region drained by the Ohio, etc., and has devoted three years to the study of the surface geology of Michigan, writes in the above connection as follows:

"The map of the Ann Arbor quadrangle, recently completed, will be of great service in interpreting the glacial history of the region it represents, as it sets forth in an admirable manner the features of the land produced by the ice sheet which once covered it. The map indicates clearly the moraines, lines of glacial drainage, the former outlines of lakes, the extent of swamps and other features of both scientific and economic importance. Its excellence should create a demand for the rapid extension of the survey on which it is based, to all parts of Michigan."

As to the value to the students of the University of Michigan, of the map referred to above, I can say without reserve, that it is all that can be asked, and will not only stimulate study, but aid in an important way in original research. To students of geology and geography it furnishes a picture of a considerable variety of topographic forms, the origin of which may be studied to advantage with its aid. To students of engineering it supplies an example of work in a highly specialized branch of surveying, and may be used in making preliminary or trial locations for railroads, trolley lines, sites for reservoirs, etc. To the students of botany and zoology it provides a base for accurately plotting the distribution of plants and animals, and for determining the conditions on which such distribution depends. In these and other ways the map of the environs of the University of Michigan will be an assistance and inspiration to her students for many generations to come.

To the citizens of Ann Arbor, Ypsilanti and other towns situated within the area represented on the Ann Arbor quadrangle, it supplies all the data for the study of sources of water supply, sewer systems, pollution of streams, drainage of swamps, etc., that could be obtained by costly preliminary surveys.

THE CONTINUATION OF THE CO-OPERATIVE TOPOGRAPHIC SURVEY OF MICHIGAN.

The topographic maps of nearly 2,000 square miles of territory in the Northern Peninsula, and of 910 square miles in the Southern Peninsula, now in hand, make a substantial beginning of what it is earnestly to be hoped will eventually result in the production of a map of similar grade of our entire State.

As already explained, the maps of the mineral regions of the Northern Peninsula, were made without assistance from the State of Michigan. Less than one-third of the expense of the surveys for the Ann Arbor quadrangle, was paid for from an appropriation made by the Legislature for the continuation of the State Geological Survey and wisely allotted

by the Board of Geological Survey for the securing of a suitable map for the use of our State geologists.

Thus far, however, no direct appropriation has been made by the Legislature of Michigan for co-operation with the United States Geological Survey, for the purpose of carrying on topographic work within the State. It is on this direct recognition and assistance by the Legislature that the continuation of the surveys referred to depends.

The estimated cost of making the topographic map of Michigan on the scale and with the degree of excellence that characterizes the portion already completed, is $8.00 per square mile; making the total expense for field and office work about $450,000.00, and the total cost to the State $225,000.00. While the total expense for a complete map of the State may seem large, it is to be remembered that the work will of necessity be distributed over a period of many years, thus making the yearly expenditure moderate. The immediate demand for a topographic survey is not the same for all sections of the State, but is great in certain portions and small in others. In view of this difference in demands, the wisest plan seems to be to have surveys made first where the necessities are most pressing, as for example, where a knowledge of the topographic conditions is important in reference to municipal improvements, drainage, education, etc., in the mining centers like the coal field of the southern peninsula, and the copper regions of the northern peninsula, and where forestry is the leading industry. As the benefits to be derived from a topographic survey of such portions of the State as have just been indicated is demonstrated, the continuation of the survey to completion will, as there seems but little doubt, be easily secured.

In a bill providing for the continuation of the Geological Survey of Michigan, introduced to the present Legislature, an item is included, appropriating $1,000 per year for two years, to enable that survey to continue to co-operate with the United States Geological Survey, in the preparation of a topographic map of the State. This measure I am sure will receive the hearty approval of the Michigan Academy of Science. Our society contains many, if not a majority, of the men of scientific training in Michigan, and as we may justly claim without egotism, should be looked to by our fellow-citizens for advice and counsel in all matters in which scientific expert knowledge is demanded in public affairs. Any recommendation which the Michigan Academy of Science may see fit to make to the State Legislature, in reference to continuing the topographic survey of Michigan, I am confident would be gratefully received by that body, and would exert an important influence in determining its action in reference thereto.

FLORA MICHIGANENSIS: ALGÆ: DIATOMACEÆ:

A LIST OF MICHIGAN DIATOMACEAE; IDENTIFIED BY H. H. CHASE, M. D., LINDEN, MICHIGAN.

1.—Achnanthes exilis, Kuetzing.
2.—A. microcephala, (Kz.)—A. Grunow.
3.—Achnanthidium flexellum, (Kz.)—Brebisson.
4.—Actinoyclus Niagaræ, H. L. Smith.
5.—Amphipleura pellucida, (Ehrenberg)—Kz.
6.—Amphiprora ornata, Bailey.—(Amphitropis).
7.—Amphora ovalis, Kz.—(deBreb.)
8.—**A. ovalis, var. minor, H. H. Chase.**
9.—**A. ovalis, var. nov.,** H. H. C.
10.—Asterionella formosa, Hassall.
11.—Campylodiscus Hibernicus, Ehrenberg.
12.—C. Noricus, Ehr.
13.—Cocconeis pediculus, Ehr.
14.—C. placentula, var. lineata, (E.)—Van Huerck.
15.—Colletonema lacustre, VanH..—(Agardh.)
16.—Cyclotella antiqua, W. Smith.
17.—C. compta, Kz.—(Ehr.)
18.—C. Meneghiniana, Kz.
19.—C. operculata, Kz.—(Ag.)
20.—Cymatopleura apiculata, W. S.
21.—C. elliptica, W. S.—(deBreb.)
22.—C. Hibernica, W. S.
23.—**C. Hib., var. rhombica, Chase.**
24.—C. solea, W. S.—(deBreb.)
25.—**C. spiralis, Chase.—Sp. nov..**
26.—Cymbella Anglica, Lagerstedt.
27.—C. cymbiformis, Breb.—(Kz.)
28.—C. cuspidata, Kz.
29.—C. Ehrenbergii, Kz.
30.—C. gastroides, Kz.
31.—C. lanceolata, Kz.—(Ehr.)
32.—C. leptoceras, (Ehr.)—Rabenhorst.
33.—C. maculata, Kz.—(C. cistula, var.)
34.—C. naviculæformis, Auerswald.
35.—C. parva, W. S.—(C. cymbiformis, var.)
36.—**C. rotundata, Chase.—Sp. nov.**
37.—C. stomatophora, Grun.
38.—Diatoma anceps, Ehr.
39.—Encyonema cæspitosum, Kz.
40.—E. prostratum, Ralfs.—(Berkeley.)
41.—E. triangulum, Kz.—(Ehr.)
42.—E. ventricosum, Kz.—(Ag.)
43.—Epithemia argus, Kz.—(Ehr.)
44.—E. argus, var. amphicephala, Grun.—(var. alpina.)
45.—E. gibba, Ehr.
46.—E. sorex, Kz.
47.—E. turgida, Ehr.
48.—E. ventricosa, Ehr.
49.—E. Zebra, Ehr.
50.—Eunotia formica, Ehr.
51.—E. major, Rabh.
52.—E. pectinalis, forma minor, (Dillwyn.)—Rabh.
53.—E. prærupta, var, bidens, (W. S.)—Grun.
54.—Fragilaria capucina, Desmazierres.
55.—F. cap., var. mesolepta, Grun.

56.—F. construens, Ehr.
57.—F. con., var. venter, (E.)—Grun.
58.—F. Harrisonii, Grun.—(Odontidium.)
59.—F. mutabilis, Grun.—(Odontidium.)
60.—F. Crotonensis, (Edw.)—Kitton.
61.—F. parasitica, W. S.—(Odontidium.)
62.—F. virescens, Ralfs.
63.—Gomphonema acuminatum, Ehr.
64.—G. acum., var. intermedia, Grun.
65.—G. acum., var. coronata, (E)—VanH.
66.—G. acum., var. sphærophora, (E)—Grun.
67.—G. acum., var. laticeps, Ehr.
68.—G. acum., var. trigonocephala, (E.)—Grun.
69.—G. capitatum, Ehr.
70.—G. dichotomum, W. S.—(Ehr.)
71.—G. Eriense, Grunow.
72.—G. geminatum, (Lyngbye.)—Ag.
73.—G. Herculeanum, Ehr.
74.—G. Herc., var. robusta, Grun.
75.—G. intricatum, Kz.
76.—G. semiapertum, Grun.
77.—G. turgidum, Grun.
78.—G. turris, Ehr.
79.—G. vibrio, Ehr.
80.—Hantzschia amphioxys, (Ehr.)—Grunow.
81.—H. amph., var. vivax, (Hantzsch.)—Grun.
82.—Mastogloia Smithii, Thwaites.
83.—M. Smithii, var, lacustris, Grun.
84.—M. Smithii, var. amphicephala, Grun.
85.—Melosira crenulata, (Ehr.)—Kz.
86.—M. granulata, (Ehr.) Ralfs.
87.—**M. lacustris, Chase.—Sp. nov.**
88.—M. varians, Ag.—(Lysigonium.)
89.—Meridion circulare, Ag.
89a.—M. intermedium, H. S.
90.—Navicula ambigua, Ehr.
91.—N. amb., var. craticularis, Ehr.
92.—N. appendiculata, Kz.
93.—N. bacillaris, Gregory.
94.—N. bicapitata, Lagerstedt.
95.—N. Brebissoni, Kz.
96.—N. cardinalis, Ehr.
97.—N. cryptocephala, Kz.
98.—N. cuspidata, Kz.
99.—N. dicephala, Ehr.—(W. S.)
100.—N. divergens, (W. S.)—Ralfs.
101.—N. dubia, W. S.—(N. viridis, var.)
102.—N. elliptica, Kz.
103.—N. ell., var. minutissima, Grun.
104.—N. exilis, Kz.
105.—N. gastrum, var., Gregory.
106.—N. gibba, (Ehr.)—Kz.
107.—N. globiceps, Greg.
108.—N. gracilis, Kz.
109.—N. Hitchcockii, Ehr.
110.—N. iridis, Ehr.
111.—N. iridis, var. affinis, Ehr.
112.—N. iridis, var. amphigomphus, Ehr.
113.—N. iridis, var. amphirrhynchus, E.
114.—N. iridis, var. firma, (Kz.) Grun.
115.—N. iridis, var. producta, W. S.
116.—N. lacunarum, Grun.—(Stauroneis.)
117.—N. limosa, Kz.
118.—N. lim., var. gibberula, (Kz.)—Grun.
119.—N. limosa, var subinflata, Grun.
120.—N. limosa, var. undulata, Grun.

121.—N. major, Kz.
122.—N. mesolepta, Ehr.
123.—N. mutica, Kz.
124.—N. nobilis, (Ehr.)—Kz.
125.—N. oblonga, Kz.
126.—N. pupula, Kz.
127.—N. radiosa, Kz.
128.—N. Rheinhardtii, Grun.
129.—N. rhomboides, Grun.
130.—N. Saugerri, Desmazierres
131.—N. sculpta, Ehr.
132.—N. scutelloides, W. S.
133.—N. serians, Kz.—(Breb.)
134.—N. parva, Ralfs.—(Gregory.)
135.—N. staurifera, B. W. Thomas.
136.—N. Tabellaria, Ehr.
137.—N. tenella, (Breb.)—Van H.
138.—N. termes, Ehr.
139.—N. trochus, Schumann.
140.—N. tuscula, Ehr.
141.—N. varians, Greg.
142.—N. viridis, (Nitzsch.)—Kz.
143.—N. viridula, (Breb.)—Kz.
144.—Nitzschia acicularis, W. S.
145.—N. closterium, W. S.
146.—N. denticula, Grun.
147.—N. dissipata, Grun.—(Kz.)
148.—N. Hungarica, Grun.
149.—N. linearis, (Ag.)—W. S.
150.—N. linearis, var. tenuis, W. S.
151.—N. palea, (Kz.)—W. S.
152.—N. palea, var. tenuirostris, VanH.
153.—N. sigmoidea, (Nitzsch.)—W. S.
154.—N. sinuata, W. S.—(Grun.)
155.—N. Tabellaria, Grun.
156.—N. vermicularis, (Kz.)—Hantzsch.
157.—Odontidium mutabile, W. S.
158.—Pleurosigma attenuatum, W. S.
159.—P. eximium, (Thwaites).—Van H.
160.—P. Kutzingii, Grun.
161.—P. Spenceri, Grun.
162.—P. Spenceri, var. minor Grun.
163.—P. Wormleyi, Sullivant.
164.—Pseudoeunotia lunaris, E.—(Eunotia.)
165.—Rhizosolenia Eriensis, H. L. S.
166.—R. gracilis, H. L. S.
167.—Rhoicosphænia curvata, (Kz.) Grun.—(Gomph.).
168.—Schizonema viridulum, Breb. (Frustulia.)
169.—S. vulgare, Thwaites.—(Frustulia.)
170.—Stauroneis acuta, W. S.
171.—S. anceps, Ehr.
172.—S. gracilis, Ehr.
173.—S. linearis, Ehr.
174.—S. Phœnicenteron, Ehr.
175.—S. phyllodes, Ehr.
176.—S. producta, Grun.
177.—Stephanodiscus astræa, Grun.
178.—S. ast., var. minutula, Grun.
179.—Surirella angusta, Kz.
180.—S. apiculata, W. S.
181.—S. biseriata, Breb.
182.—S. cardinalis, Kitton.—(limosa, Bailey.)
183.—S. linearis, W. S.
184.—S. lin, var. constricta, W. S.
185.—S. Norvegica, Elulenstein.

186.—S. Oregonica, Ehr.
187.—S. ovata, Kz.
188.—S. splendida, Ehr.
189.—S. Saxonica, Auerswald.
190.—Synedra capitata, Ehr.
191.—S. Crotonensis, Grun.—(Fragilaria.)
192.—S. Crot., var. prolongata, Grun.
193.—S. Danica, Kz.
194.—S. delicatissima, W. S.
195.—S. lanceolata, Kz.
196.—S. longissima, W. S.
197.—S. pulchella, Kz.
198.—S. rumpens, Kz.
199.—S. rumpens, var.—Grun.
200.—S. spathulifera, Grun.
201.—S. splendens, Kz.
202.—S. ulna, Ehr.—Grun.
203.—S. ulna, var. Chaseii B. W. T.
204.—S. vitrea, Kz
205.—Tabellaria fenestrata, Kz.
206.—T. flocculosa, Kz.

THE LICHEN GENUS PHYSCIA.

E. E. BOGUE, AGRICULTURAL COLLEGE.

The person who begins the collection of lichens in this region will find Physcia stellaris among his first ten.

At first sight lichens may seem to be in a bad mix up, but we do not proceed far, provided we get started on the right track, before we discover that like all other organic bodies there is something of a natural sequence.

The arrangement of the higher groups of lichens is now fairly settled and will probably remain about as they are until some one thinks they need an overhauling when he will turn the present arrangement topsy turvey, and then we shall need some new guide posts along the lichen road.

According to Tuckerman, our lichens are placed in two series, which are named much like the series of flowering plants, viz., Gymnocarpi or naked fruit and Angiocarpi or covered fruit. The Gymnocarpi are further divided into four tribes, sixteen families and sixty-two genera. The Angiocarpi, into one tribe, two families and ten genera. Physcia is the fourth genus of the second family of the first tribe of Gymnocarpi and is related to Parmelia on the one hand and Pyxine on the other.

In lichens the fruiting body is called an apothecium, in certain groups of fungi perithecium. As in other forms of vegetable growth, the fruit is the thing we need for classification in most cases. The species of Physcia generally fruit freely but there are some common species whose fruit I have never seen during twelve years of study and observation of lichens.

The fruit is borne in little receptacles that in build are like miniature patterns of the thick, heavy saucers that accompany the cups in which we are served coffee at the short-order restaurant. These apothecia are modified developments of the lichen thallus or the part that forms the most conspicuous part of the plant. The species of Physcia may be found on the bark of both live and dead trees, dead wood, stone and other substances. The thallus is frequently broken up into small pieces, especially in the older portions, and is usually represented by radial, broken, branched bands or may be in scattering small pieces that have no definite arrangement. The thallus is for the most part some shade of green above and sometimes white beneath. Little black fibrils are usually present beneath. The spores are ellipsoid, brown, and in our native species show only one division. Tuckerman enumerates thirty species and varieties in his "Synopsis of N. A. Lichens." Of these I have sixteen in my collection and no especial attention has been given to this genus. There is a larger number of some other genera.

Physcia speciosa.—This will be found with a rather compact leathery thallus on bark, stones and among moss in woods. It is what the horticulturist would call a shy bearer, for I have it from seven different localities by four different collectors and not a single fruit is to be found.

Physcia hypoleuca is found in situations very similar to speciosa, but is frequently in fruit.

Physcia comosa is very often found on the dead and green twigs of cedar trees, usually in abundant fruit. The fibrils are conspicuous.

Physcia aquila detonsa.—I do not know that I have ever seen the species, but the variety detonsa is common among moss at the base of trees and frequently abundant in fruit.

Physcia pulverulenta.—This is found on rocks and tree trunks. Common on limestone fences. The thallus has a bluish cast in its younger portions, the older portions soon breaking up. No more sorediate or powdery than some other species.

Physcia pulverulenta leucoleiptes.—In this variety the thallus has a more distinct bluish or bronze tint. Found in similar situations.

Physcia leana.—This has been collected but once. The record of the locality is so indefinite that the spot cannot now be determined. The type specimen in the Tuckerman collection at Harvard is not readily distinguished from other forms on the same herbarium sheet.

Physcia stellaris.—By far the most common species of the genus and perhaps more common in our region than any other lichen. It is very variable, often appearing in scattered bits of thallus, but frequently the thallus may be called stellate.

Physcia astroidea.—This I have never seen in fruit. It is often seen on the bark of such trees as the basswood, papaw, and apple. Clings closely to the bark; white spots of soredia are conspicuous.

Physcia crispa.—This much resembles the following tribacia, but the thallus is more compact. I have collected it but once and that was on a tree standing on the large circular earthwork of the moundbuilders at Newark, Ohio.

Physcia tribacia.—A good place to find this is on the bark of such trees as hickory and cedar. The thallus is whitish and broken up into small bits.

Physcia caesia.—This I have on granite rock collected in Iowa. It seems to be infrequent. It resembles the preceding.

Physcia obscura.—A common lichen on rocks and tree trunks. The thallus is likely to be separated into fragments but is not obscure, although of a dark green color.

Physcia obscura endochrysea.—This will be recognized by an apparently diseased condition of the thallus, causing brick-red spots to appear. Often found among mosses at the base of trees.

Physcia setosa.—This resembles obscura but is lighter colored and the fibrils are numerous on the edge of lobes. Found in similar situations.

Physcia adglutinata.—As the name implies this lichen appears closely appressed to the substratum. It is frequent on the smooth bark of trees like that of basswood and upon rocks.

Few of the remaining species occur in our region but are southern, western or Arctic. I should like to give here a synoptical key to the arrangement of the genus but it could not be made reliable without the use of microscopical characters.

The lichens are delightful plants to study, but they have little if any economic interest. No insects disturb them in the collection. The literature is scanty and scattered.

NOTES ON MICHIGAN SNAKES.

HUBERT LYMAN CLARK.

Since the last meeting of the Academy, observations have been continued on the reptiles of Eaton county, and the following notes seem worthy of record. Many of those on water-snakes are supplementary to the account of the water-snakes of southern Michigan, published in the American Naturalist for January, 1903:

Natural History.—A small male red-bellied water-snake (*Natrix erythrogaster*) has been kept in captivity since May 5, 1902. During the summer he shed his skin not less than four times though he has apparently not undergone any change in size and color. Since September he has eaten nothing, but the young man who looked after him during the summer said that he ate about one frog a week. March 17th three live frogs were placed in his cage, but he has showed no disposition yet (March 24) to eat any of them. During the winter he spent much of his time at the bottom of his pan of water, apparently torpid, and certainly not coming to the surface to breathe, for hours at a time. A large female garter snake has been confined with him since September and she also sought the water during the cold weather, (the laboratory is not heated at night), but always coiled in such a position that her nose was out of water. So far as I could judge, air was essential to her, but not to the water-snake. Yet observations made on water-snakes in the early spring lead me to believe that they do not normally hibernate under water. On the contrary, garter-snakes, ribbon-snakes, water-snakes of both species, and blue racers were all found on the first warm days of the present spring (1903) sunning themselves under such conditions that I am led to believe they all winter in similar situations, in holes and cavities under brush heaps, fence rows, stumps, etc. On those days when they first come out of their winter quarters, they are all very sluggish, even the blue-racer being comparatively easily captured with the hand. But a few days of warm weather brings back their activity. All of our snakes will bite if carelessly handled, but the pilot snake (*Coluber obsoletus*) is remarkable for its gentle disposition. It makes a very interesting pet, especially on account of its extraordinary ability as a climber. During the year the following snakes have bitten me or one of my students: Garter-snake, pilot-snake, blue racer, water-snake and red-bellied water-snake. In every case the result was the same; no appreciable pain was felt, the blood flowed freely, the wound gave no discomfort and it healed with remarkable rapidity. A bite from one of our non-venomous snakes is apparently less serious than a scratch from a pin.

Edibility.—The use of snakes for food has never met with wide favor and probably the fish-eating snakes would not be agreeable. But the blue-racer (*Zamenis constrictor*) is edible, though the meat has no special flavor. We have tried it fried, and also "devilled" and made up in sandwiches. In the former case, those who had the courage to try it pronounced it good and asked for more, while in the latter case, the sand-

wiches were distributed at a small reception and some thirty students of both sexes ate them, not knowing what they were. All agreed there was nothing disagreeable about them, while many of the young ladies thought them very good, and some supposed they were chicken. The meat is white, somewhat like that of frog's legs, but rather more tough and stringy.

Variation.—The question of variation in snakes demands careful study from living specimens, no preserving fluids serving to keep the colors or proportions with accuracy. Among our Michigan snakes there is no one which will better repay investigation than the common milk snake (*Oxcola doliata triangula*). I have seen few specimens from this State, but they are so entirely different from the Massachusetts specimens of what is supposedly the same subspecies that there is little doubt in my mind that they are distinct.—In my paper on water-snakes, already referred to (American Naturalist, January, 1903), several points in regard to the variability of *Natrix* are brought out, which are of some interest, the most important being the apparently greater variability of females. Investigations on these points are now being carried on as extensively as living material permits. The recent warm weather brought out the snakes in large numbers and 109 specimens have been examined. A hasty survey of these statistics confirms my observations of last year showing that females are externally distinguishable from males, that they are much more variable, and that the lower jaw is much more variable than the upper.—In the "Ohio Naturalist" for January, 1902, is an interesting account by Max Morse of variations observed by him in a brood of thirty-three young water-snakes (*Natrix fasciata sipedon*), which were taken from the body of the mother. I have recently examined a similar brood of thirty specimens of the same species, and a comparison of our results is interesting. Unfortunately my specimens are alcoholic, and I have therefore made no measurements. On the other hand, Morse makes no reference to sex (which can be easily determined even in these unborn young) nor to the labial plates, nor to the urosteges, while his remarks in regard to the number of scale rows indicate that he does not understand that the number of longitudinal rows where most numerous is what is meant by "number of scale rows." His statement in regard to rows converging is true of practically all snakes. As a result of my inability to make measurements, and his failure to record at least four important points, our observations are comparable only in the number of postoculars and gastrosteges and in the position of the umbilicus. Of his thirty-three specimens, only eighteen had three postocular plates on each side of the head, three others had three on the right side, one had three on the left side, while eleven had only two on each side. Of my thirty specimens, only one, a female, fails of the normal number, she has two on the right side, three on the left. Here is certainly a notable difference between the Ohio and Michigan broods. In number of gastrosteges, Morse gives the maximum as 150, the minimum as 142, the mean as 144.8. My specimens show a maximum of 146, minimum of 139, mean of 142.3. At first sight this seems like a notable difference, but I think it probable that it is not real. In my figures, the anal plate and the more or less triangular plate on the chin which heads the series of gastrosteges are never included. There is reason to believe that Morse has included them, and if so, then the Ohio and Michigan snakes are strikingly alike in the number of gastrosteges. Morse does not list any half-

plates among the gastrosteges, but twelve of my thirty specimens show them. They are counted as gastrosteges in my figures. As regards the position of the umbilicus, Morse found the number of gastrosteges in front of it to vary from 123 to 133 with an average of 128; my snakes show a range of from 123 to 131 with an average of 127. If Morse has counted the chin plate just referred to, then our figures are again almost identical. In my snakes, the umbilicus occupies two plates, and there are from fourteen to eighteen plates back of it, with an average of a little over fifteen. Morse does not give particulars on this point.

On comparing the statistics of the thirty young snakes, with those of the adults studied last year, some interesting facts are brought out. Just half of the thirty are males, the brood consisting of fifteen specimens of each sex. In the number of gastrosteges they agree perfectly with my "American Naturalist" figures, ranging from 139 to 146, with a mean of 142.3, while those published range from 138 to 148 with a mean of 142. In the number of urosteges there is a similar agreement; the fifteen males have from 68 to 78 with a mean of 72.1, while the females have from 59 to 67 with a mean of 62.5; the mean given in the "Naturalist" for small males is 72.6 and for small females 62.6.—Turning now to the variations in the number of labials and scale rows, we find that the fifteen young males before us are unusually aberrant in the number of labials, while the fifteen females are even more aberrant in the number of scale-rows. Thus as regards the labials the two sexes vary about equally, there being eleven males and ten females with the normal eight upper labials on both sides, but only seven males and eight females with the normal ten lower labials on both sides. Each sex shows sixteen aberrations from normal, and all these are due to *added* labial plates. Of the thirty-two aberrations, twenty are in the lower jaw, confirming the figures given for adults. Curiously enough six of the twelve aberrations in the upper jaw, and ten of the twenty in the lower jaw are on the right side, confirming the previously expressed opinions that variations are as likely to occur on one side as on the other. In number of scale-rows every male is normal, having twenty-three rows, while of the fifteen females only five have twenty-three, four have twenty-four and six have twenty-five. Thus of fifteen males, six or forty per cent. were normal in both the number of scale-rows and of labials, while of the fifteen females only two or thirteen per cent. were normal and one of those two has only two postoculars on one side and is therefore abnormal. One of the abnormal males is remarkable for having a supraloreal plate on each side, the first I have seen in *Natrix*. Of the twelve snakes with half plates among the gastrosteges eight are females, and one of these has two such plates. Moreover of the ten snakes with sixteen plates back of the umbilicus, six are females, and the one with eighteen plates there is also a female. For all these reasons I feel that the examination of these young water-snakes confirms me in the opinion that the female is more variable than the male.

VARIATION IN THE COMMON GARTER-SNAKE (THAMNOPHIS SIRTALIS).

W. L. SPERRY.

The results of the investigation summarized in this paper represent work carried on during the spring and early summer of 1902 upon the variations in the common garter-snake. The reasons which led to the work may be stated briefly as follows: Cope in his exhaustive work on the Ophidia of North America has carried his classification into subspecies so far that the amateur naturalist becomes hopelessly confused in trying to locate many of the forms and the zoologist is often at a loss to know just where to place a certain specimen. The attention of the writer of this paper was particularly called to this in trying to place some of the garter-snakes which were picked up near Olivet and were difficult to classify satisfactorily from Cope's work in which he gives eleven sub-species of *Thamnophis sirtalis*, the only appreciable difference between them being the matter of coloration. The variations are largely a matter of relative shades of brown and green on the back, and blue or green on the belly, and the distinctness of the stripes and spots on the back. The only absolute distinction of color seems to be the introduction in many of the individuals, of a series of red blotches just below the lateral stripes, which are common in many garter-snakes and which are familiar to any one who has noticed their coloration. The color changes so frequently, even in a single individual, varying with the freshness of the skin, and in preserved specimens (from which Cope largely worked), with the quality and strength of the preservative, that it seemed there ought to be some further differences in the number of gastrosteges (stomach plates) and the number of urosteges (tail plates), or perhaps in relative measurements, to justify the subdivisions Cope has made. Hence the work was undertaken with a view of finding, if possible, some correlation between color, and proportions and scale variation. As the investigation went on it became evident that the results were largely negative, but a most interesting set of statistics upon the relative variation of the sexes was obtained and the work drifted largely into that channel. The outline followed in the work and in this paper is identical with the outline which Dr. Clark followed in his investigation of the common water-snake (*Natrix fasciata sipedon*) and the red bellied black-snake (*Natrix erythrogaster*), the results of which are embodied in a paper published in the "American Naturalist" for January, 1903.

The natural history of the garter-snake is so well known that we need hardly tarry over it. As Cope says: "This species ranges all over North America, being limited to the north by its capacity for enduring cold and extending south to Guatemala." It is probably the most common snake in the northern and eastern United States and is found in nearly every locality and in the most varied surroundings. During the period when the snake is shedding its skin, i. e., the late spring and

early summer, the majority are found near the ponds and brooks as water is an essential feature of the molting. Most of the snakes collected were taken near the ponds and streams which are abundant in the vicinity of Olivet. One hundred and forty-eight individuals were collected and the following observations made on each one; sex, length of head, length of tail, total length, number of gastrosteges, number of urosteges, number of upper and lower labials on each side, maximum number of scale-rows and color. The first topic which comes up for consideration is

THE DIFFERENCES DUE TO AGE.

Any one who has given attention to the subject of variation will have noticed that many of the features change very markedly during the transition from the younger to the older stage. Relative measurements for instance, vary quite noticeably. Having to make some arbitrary distinction for a comparison, I said that all snakes under 400mm. in length were young, while those over 750mm. were old. Tabulating upon this basis the relative length of head and tail it was found that in the younger snakes both were slightly longer than in the adults. In the young snakes the tail was twenty-two per cent. of the total length, while in the older snakes it was 21.3 per cent. of the length, a difference of .7 per cent. The head was also relatively longer in the younger individuals. In these specimens the head was 4.5 per cent. of the body length, while in the adults it was only 3.3 per cent., a difference of 1.2 per cent., showing that the greatest per cent. of growth between the two extremes of age takes place in the body proper.

THE DIFFERENCES DUE TO SEX

Were much more marked and much more interesting. After a little experience one can tell the sex of the snake by the external appearance alone, with little danger of mistake. The female is, as a rule, much thicker and more solid than the male and, in maturity, longer. Nearly all the snakes over 750mm. in length and all of those over 800mm. were females. The tail of the female is also relatively shorter, and one can usually tell at a glance, whether his specimen is male or female by this difference. Of the 148 individuals examined, sixty-three were males, and in these specimens the tail averaged 23.3 per cent. of the total length, while in the female it averaged 20.9 per cent., a difference of 2.4 per cent. of the total length. It was interesting to note in connection with this observation that there was no single point that marked the dividing line between the two sexes, but that the minimum male and the maximum female overlapped considerably. In connection with this increased length of tail in the male the statistics showed that this difference was not accompanied by increased width of the urosteges or tail plates, but by increased number. In the males the number of pairs of urosteges varied from 65-81 giving an average of seventy-three, while in the female it ranged from 57-71 with an average of sixty-four, giving the male approximately nine more pairs of urosteges than the female. Comparison also showed, as we should expect, that in each sex there was a very marked correlation between the number of urosteges and the relative length of tail.

Males with tail twenty-four per cent. total length or over, averaged 75 urosteges.

Males with tail less than twenty-three per cent. length, averaged 71 urosteges.

Females with tail twenty-one per cent. total length or over, averaged 65 urosteges.

Females with tail less than twenty per cent. length, averaged 61 urosteges.

GREATER VARIABILITY OF THE FEMALE.

One of the points in which there seemed to be considerable individual variation was the number of right and left upper and lower labials, and the tabulation showed that seven per cent. more of the females were variable in this respect than the males.

Seventy-eight per cent. of the females had labials $\frac{7\text{-}7}{10\text{-}10}$ (regular).

Eighty-five per cent. of the males had labials $\frac{7\text{-}7}{10\text{-}10}$ (regular).

One other interesting fact came to light, though it may not have any significance and probably would change if a larger number were examined.

Nineteen abnormal females showed thirty-three variations of which fifty-five per cent. were added plates.

Nine abnormal males showed eleven variations of which none were added plates.

Statistics also showed that the lower jaw was more variable than the upper. Of the 148 individuals examined, eighty-eight per cent. of the females and ninety-eight per cent. of the males, averaging ninety-four per cent. of the total number, had the normal number of labials in the upper jaw (7-7), while only eighty-six per cent. of the females and eighty-seven per cent. of the males, eighty-six per cent of the total number, had the normal number (10-10), in the lower jaw. There was no marked difference between the right and left sides. Twenty-five of the forty-four aberrations were on the left side and nineteen on the right. Of the fifteen aberrations in the upper labials, six were on the right side and eleven were added plates. Of twenty-nine aberrations in the lower labials, thirteen were on the right side and seven were added plates.

SIMILARITY BETWEEN VARIATIONS IN GARTER-SNAKES AND WATER-SNAKES.

When a comparison was made between the results of my season's work and that of Dr. Clark upon the forms of *Natrix*, it was interesting to find that there was a striking similarity between the variations in these two genera. The differences, due both to age and sex, are in many cases almost identical. The water-snakes show the same greater relative length of head and tail in the young that is found in the garter-snake. The range in the number of urosteges in the two species of water-snake was 58-82, while in the garter-snake it was 57-81. The same correlation between length of tail and number of urosteges was observed in both genera. In the water-snakes, as in the garter-snakes, the females showed greater variability in the number of labials and the similarity was carried through to the end by finding that the greater variability of the lower jaw, and lack of distinction between the left and right sides held in both forms. The only difference observed was in the rela

tive number of scale-rows. In the water-snake the normal number of scale-rows is twenty-three and only eighty-two per cent. of the individuals examined were normal in this respect, many of them having twenty-four and twenty-five rows. In the garter-snake the normal number is nineteen, and of the 148 examined not a single individual showed any variation.

NO CORRELATION BETWEEN COLOR AND OTHER VARIATIONS.

When the work upon the age and sex variations had come to an end an attempt was made to find some differences in relative measurements or number of ventral plates, which should correspond to the color differences but it was unsuccessful. The majority of the individuals taken were either *Thamnophis sirtalis sirtalis or Thamnophis sirtalis parietalis,* distinguished by the presence of red blotches beneath the lateral stripes and the absence of gastrostegal spots in the latter sub-species. The outline which was followed in the color classification was one which the writer arranged to meet the needs of the case and was as follows:

Red in lateral stripe
No constant gastr. spots, dorsal stripe not prominent.
Constant gastrostegal spots.
Dorsal spots evident
Back blackish.
Back greenish.
Back brownish.
No red in lateral stripes
Dorsal and lateral stripes yellow
Dorsal and lateral stripes green
Dorsal and lateral stripes very dull

Making the distinguishing point the presence or absence of red, the results of the tabulation were, briefly, as follows:

Individuals with red, average relative length of head .0367, without red .0360.

Individuals with red, average relative length of tail .222, without red .218.

Individuals with red, average number of urosteges 68, without red 69.

Individuals with red, average number of gastrosteges 152, without red 153.

Individuals with red, eighty-three per cent. as to labials, without red seventy-nine per cent. regular.

From these facts it will be seen that there is no difference which might not vary one way or the other with further examination and that the color variation is the only one which warrants any division into sub-species. There are undoubtedly marked differences between many of the garter-snakes in this respect, but it would simplify the classification if this were regarded as a matter of individual variation rather than a sign of differentiation into sub-species. In the first place the age largely affects the coloration. Those who are acquainted with the life history of the blue-racer will know that the young are very different from the adults, in having a checkered marking on the back, much like that of the common water-snake, and do not acquire the peculiar uniform

steel blue color, which is characteristic of the species, until later in life. Hence it has seemed entirely possible, and even probable that the garter-snakes change the shades and distinctness of the markings with the years, if not with the seasons. No opportunity has been given, as yet, for protracted observation upon this point, but it seems reasonable to believe that further study will substantiate this view. Cope was unfortunate in having to deal largely with alcoholic specimens in making up his classification. The propensity which alcohol has for eradicating certain colors and intensifying others is so well known that nothing need be said upon that point. If, however, we could find a sharp dividing line of coloration between these sub-species, their recognition would be desirable, but as Cope himself says: "Transitions between these forms are common. The disappearance of the spots and stripes of *Thamnophis sirtalis sirtalis*, which culminates in *Thamnophis sirtalis graminea*, does not occur abruptly, but transitional specimens are not hard to find, etc." The writer of this paper has seen a snake which he should have confidently called *Thamnophis sirtalis graminea* shed its skin and become *Thamnophis sirtalis sirtalis* by the process, so does not feel that color variation alone is sufficient ground for subspecific distinctions.

The tendency to carry classification to an extreme is one which characterizes a great deal of the systematic work of the present day, and is perplexing even to the specialist as well as the amateur. There is, however, such a thing as confusing individual variation with essential variation and we should not be over hasty in subdividing species without careful comparison of all the features. The purpose of this paper is merely to set forth the facts as they came to light from some ten weeks' work and suggest some of the obvious conclusions.

THE CHEMICAL INDUSTRIES OF MICHIGAN.

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It is perhaps advisable at the beginning of this paper to recognize that there is a great difference in the lists of those industries which *are* actually chemical industries and those which *ought* to be chemical industries, but unfortunately are not conducted in such a way as to entitle them to that distinction. The manufacturers of metallurgical, electrochemical, and pharmaceutical products, of alkalies, cements, sugar and varnishes have always recognized the necessity of strict chemical control of their operations.

There are instances of well-conducted works in every other industry, and the large and flourishing factories are almost always found to be under chemical control. The pressure of competition of these modern factories is causing continually larger numbers of manufacturers to break away from the rule of thumb methods handed down by tradition, and to seek the aid of scientifically trained men in the conduct of their business.

The recent completion of the reports on manufactures of the twelfth census allows us to review with some reliability the status of the chemical industries of Michigan. Under the heading "Chemicals and Allied Products" we find the following list in the Census Bulletin:

Industry.	Value of product.
Sodas	$2,826,377
Potashes	77,609
Alums	39,500
Wood Distillation	514,106
Fertilizers	353,608
Bleaching Materials	62,387
Electrochemical Products	193,256
Tanning Materials	100,684
Paints, Colors and Varnishes	3,391,773
Explosives	691,766
Essential Oils	202,258
Compressed and Liquefied Gases	2,976
Chemicals not otherwise specified	1,300,784
	$9,757,084

Michigan ranks as the sixth State in the Union in the value of chemical products thus enumerated, being surpassed by New York, Pennsylvania, New Jersey, Ohio, and Illinois, standing in the order named. In the average number of people employed, however, Michigan takes fourth place, surpassing both Ohio and Illinois.

It will be noted that the paint, color and varnish industry ranked first in the value of its products during the census year, with soda manufacture in the second place. These positions have probably been reversed

by the great enlargement of the works of the Solvay Process Company near Detroit, which will probably this year, 1903, give Michigan first rank in the United States as a producer of soda ash. This list contains only a small number of the chemical industries. It does not include the product of the large Detroit manufacturers of pharmaceutical supplies, which are elsewhere listed as producing $4,921,913 worth of goods during the year. Neither does it include the tanning of leather (product valued at $6,015,590), manufacture of soap and candles ($706,238), the production of malt liquors ($5,296,825), nor the manufacture of illuminating gas and its by-products ($1,388,585), all of which are, or at least ought to be, chemical industries.

Especial attention may well be directed to two of the most important and rapidly growing chemical industries in the State—cement and sugar—which rely upon the chemist's knowledge and upon chemical control in every step of the manufacture. The strides made by these industries in the last five years have been enormous.

Portland cement has been manufactured at a few places in this State for many years, but it was not till 1898 that it commenced to develop into a great industry. The following table shows the increase in production and value of product with each year.

PORTLAND CEMENT PRODUCTION IN MICHIGAN.

	Bbls. of 400 lbs.	Value.
1898	81,500	$162,125
1899	402,000	701,000
1900	598,407	831,786
1901	1,025,718	1,128,290
1902	.....	.....

Michigan stands third among the States as a producer of Portland cement; Pennsylvania being far ahead, and New Jersey coming second with an output not much greater than Michigan.

SUGAR.

The sugar industry in this State is entirely a growth of the last five years. The first factory commenced operations in the fall of 1898, and in the campaign of 1898-99 produced 5,271,000 pounds of white sugar. During the past campaign of 1902-3, there were sixteen factories in operation and the estimated production was 100,000,000 pounds.

	Factories in operation.	Production in pounds.
1898-9	1	5,271,000
1899-1900	8	32,737,098
1900-1901	10	64,616,358
1901-1902	13	104,590,080
1902-1903	16	100,000,000

The value of the last campaign's sugar was about $4,500,000.

The excessive rainfall of last summer made the season a disastrous one for both beet growers and manufacturers, and kept the industry from

showing the large increase in product which it would have in a normal season. As it is, Michigan last year produced about three-fourths of the sugar it consumed, and if the coming season is a favorable one, will have sugar for export after having satisfied the home demands. Michigan ranks as the second State in the Union in the production of beet sugar, producing almost thirty per cent. of the total amount manufactured. California stands first, producing about thirty-six per cent. of the total, but this year would have lost its supremacy to Michigan had the crop in this State been at all favorable.

It is interesting to note how one industry brings others in its train. The forests of Michigan with cheap charcoal brought the charcoal iron furnaces to this State, and the last census reports seven establishments as still in existence, with an output during the census year valued at $2,327,153, which is about two-fifths of the total value of the United States product. The charcoal burners have collected more and more carefully as competition pressed them, the acetic acid and methyl alcohol from their kilns, until now in a well-conducted works the value of the once neglected by-products has become greater than the charcoal. Furthermore, since small wood yields almost as much of these products as good lumber, one of the largest saw-mills of the State has recently installed an expensive chemical works to take care of the slabs and refuse from the mill, where methyl alcohol and calcium acetate are principal products, and charcoal a by-product.

In a somewhat similar way the ammonia produced in the destructive distillation of coal and wasted from the old beehive coke furnaces has become such a valuable product that the Solvay Process Company has extended its by-product coke oven plant to such an extent that it has a large amount of gas to sell to the Detroit Gas Company, and has brought about the erection of an iron furnace near its plant to take care of its surplus coke. Michigan will then appear as a producer of coke pig iron as well as the charcoal iron.

The magnitude of Michigan's copper industry is well known. Not all the product of her mines is refined in this State, but the census returns show three copper smelting and refining establishments with an output of refined copper valued at $17,340,041.

The electrochemical industries of Michigan should be mentioned not so much because of the present value of their products as because of their promise for the future. The tendency of these industries has been to collect around sources of cheap water power, and their concentration at Niagara is well known. The recent completion of the American power canals at Sault Sainte Marie with its 40,000 available horse power has already attracted some manufacturers and plants for the manufacture of alkali and bleaching powder, calcium carbide, and for the electrolytic refining of copper and nickel are reported to be making arrangements to locate there. There is abundant room for the erection of plants for the production of bleaching powder in this country, nearly seventy-five per cent. of the amount consumed being imported. The factories at Niagara produce most of this, but Michigan ranked second in output during the census year. The raw material, salt, is cheaper in Michigan than in any other State, and Michigan has almost continuously taken the lead in its production. It is worthy of note that this industry has developed in this State without the advantage of cheap water power and that though the

water power at the "Soo" is attracting some manufacturers, others have decided it is more economical to locate near the markets and salt deposits, as is shown by the erection of the large plant now nearly completed of the Pennsylvania Salt Manufacturing Company at Wyandotte.

If we summarize these industries we find for the value of the products of the chemical industries of Michigan for the census year (except for cement and sugar for which later values are given):—

Soda, Bleaching Materials, and Electrochemical Products	$3,080,020
Paints, colors and varnishes	3,391,773
Other industries included in Census Bulletin on "Chemical and Allied Products"	3,285,291
Druggists' Preparations	4,291,913
Tanning of Leather, etc.	6,015,590
Soap and Candles	706,238
Malt Liquors	5,296,825
Illuminating Gas and By-products	1,388,585
Portland Cement (1902 estimated)	2,500,000
Sugar (1902-3 estimated)	4,500,000
Pig Iron	2,327,153
Refined Copper	17,340,041
	$54,123,429

There are very few States, notably New York and Pennsylvania, which surpass Michigan in the variety and magnitude of their chemical industries. Michigan's advance in this line during the past ten years has been extraordinary and the State seems destined to more than hold its own in the future.

HISTORICAL REVIEW OF THE GEOLOGY OF MICHIGAN.

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The earliest published work referring to the Geology of Michigan was read before the Geological Society of London in February and March, 1823,[1] before Michigan had become a State and indeed, before the territory now comprising the State had been entirely released by Great Britain.[2]

Dr. Bigsby was surgeon on Drummond Island at Fort Drummond which was still held by the British. In this report are already identified and separated; the Lake Superior sandstone; "the limestone of St. Joseph," which we now call the Trenton; the "limestone of the Manitouline," which has been since known as the Niagara; the gypsum deposits of the Isles of St. Martin which represent the Salina and the "cavernous and brecciated limestone of Michilimackinac," which was later called the Helderberg. It will be noticed that these names have since been replaced by names from New York localities which possess more or less equivalent rocks, but I think the time is at hand when we shall see clearly that these names are not really equivalent in their New York and western usage and shall return for our western usage to those old names, which have priority anyway. He describes a number of fossils and gives a careful description of the petrographic character of these different layers. For nearly twenty years there was no addition to our systematic knowledge. Then the Geological Survey under Douglass Houghton began.[3] The proceedings of this Survey are scattered through a lot of House and Senate documents and are almost impossible to obtain. For this reason they have not received the attention they deserve, both as to surface and general geology. Moreover, the work was interrupted by the death of Dr. Houghton in 1847, and many of the illustrations never saw the light. By this Survey the coasts of both Peninsulas were carefully skirted and the presence of coal in the interior of the Lower Peninsula and the general distribution of the copper bearing rocks and the iron bearing rocks of the Upper Peninsula were laid out. Originally, the circular basin like arrangement of the beds in the Lower Peninsula was not understood, but before their work was finished they had arrived at correct views.[4]

Houghton had just arranged for a system of co-operation with the U. S. Land Office in the Upper Peninsula, by which geological observations were to be made in connection with their subdivision. This very promising plan was never thoroughly carried out, but a mass of information was accumulated which enabled the next Geologists to publish, to cover and get practically correct a vast amount of territory.

The general government next took a hand, and under C. T. Jackson[5] and Foster and Whitney[6] a report was prepared which included much of the work of Houghton and his assistants and covered the Upper Peninsula with a considerable degree of accuracy. They were assisted by

Desor on surface geology and James Hall on the paleontology and sedimentaries, and also by Burt and Hubbard of the Michigan Survey and Williams, Stevens and Hill. Let us compare the amount of information attained at this date. The broad bands of sedimentaries in the eastern half of the Upper Peninsula sweep around substantially as they do on my latest map. No finer subdivisions have been made in the sedimentaries and no material error has been corrected with the one exception that the upper Helderberg of the Devonian System is extended much too far north. Passing to the pre-Cambrian rocks we find the great range of copper bearing rocks, which, by the way, were then classed with the Silurian, extending from Keweenaw Point to the Wisconsin line and dipping towards Lake Superior and re-appearing on the other side of Lake Superior in Isle Royal where they dip to the southeast. The rocks prior to the copper bearing rocks are divided into crystalline schists and granite, corresponding roughly, but with fair distinctness with the Laurentian or Basement complex and the Huronian or Lower Algonkian of later writers. The main questions left, which were not altogether settled to the entire satisfaction of everyone, are as follows: What are the relations of the red sandstones which appear both to the northwest and southeast of the Keweenawan Copper Range and how nearly are they the same? What are the mutual relations of the sedimentary and igneous rocks associated in the Azoic system, which Dana later called Archean, and what are the details of the stratigraphy? The geology of the Upper Peninsula as left by Foster and Whitney[2] was as well or better known than that of the Lower Peninsula, and its mineral wealth attracted the attention of the mining men of Europe. Fr. C. L. Koch[5] gave an account of his trip and a map, which though based upon Foster and Whitney, gives considerable more detail in some parts and gives a more accurate petrographic description of the melaphyres or traps and amygdaloids of the copper bearing rocks. Rivot,[6] a French geologist, also made a trip but the observations of these geologists had little effect on the course of progress for they were overlooked and rediscovered independently by later writers.

With the revival of the Geological Survey under Alexander Winchell interest and progress is shifted to the Lower Peninsula and his report,[7] issued in 1861, contains a clear and generally accurate account of the general stratigraphy of the Lower Peninsula, with a mass of further information regarding the occurrence of coal and salt. Though this report contains no geological map, it should be read in connection with the articles[8] on Michigan and the maps prepared therewith, which he prepared for the Walling-Tackaberry Atlas, issued in 1864-5, 1866, 1873. By this time the general outline of the Coal Basin had been determined, and the general basin-like structure and the principal horizons of the succession of rocks beneath. The only thing that can be said in a general criticism is that the thickness of the various formations was uniformly underrated. One point occupied Winchell's time and attention for a number of years and a series of papers,[9] and that was the Marshall Group. The state of affairs is about as follows: New York was the first State in which the Paleozoic column was thoroughly worked out in detail and it has been used as a norm by geologists of other States. In that State we find, beginning at the base of the upper Devonian with a black shale, a series first of blue shales, then of fine-grained bluish and greenish

sandstone growing coarser and coarser and culminating in red beds and conglomerates, and emergence of the land and a cessation of deposits. This series is known as the Portage-Chemung-Catskill, and all these rocks are supposed to belong to the Devonian, representing plainly part of one physiographic cycle. Now when we come to Michigan we find a similar lithological and physiographic succession. Beginning with the black shales, which Winchell called Huron, and we now call Antrim, we have a similar succession passing through blue shale, blue and green sandy shales and sandstone to heavy sandstone. It was natural for the New York Geologists to correlate them with their own series, but Winchell found that the uppermost beds of this series, which he called the Marshall Group, were fossilferous, especially in the lower part, the upper part being a heavy sandstone in which fossils are rare. These fossils he maintained were distinctly Carboniferous in character and though the controversy lasted some time there is no doubt that he was right, so that at least the upper part of this series must be put into the Carboniferous, just how much it is often hard to tell. We have here a case in which the progress of geographic evolution and that of organic evolution did not keep pace. The continent emerged earlier in New York than in Michigan and the fauna did not migrate paripassu.

We have now the geology of the State mapped out in broad and general outlines, except that very little was yet known regarding the detailed superficial geology, except that the lakes had once been higher and retired and that the ice had once played a much greater role in distributing erraties. Mr. Leverett takes up this matter so that for me there remains only to describe the work of correction and filling in, and yet this is of no mean importance, either theoretically or practically. The next geological survey was started in 1869. It is worthy of remark that just as Michigan has very strong State Institutions, while the private colleges are comparatively weak, so most of what has been done geologically, has been done officially, and we have not had that wealth of information which in other States has come from private initiative. One exception to this is in the work of the Kent Scientific Institute about at this time,—another is of the Lake Superior Mining Institute at present. Of course much of the scientific information has been gathered by State Officers from developments made for private ends, with their testings, drillings, etc. In 1869 the Survey as re-organized[10] had Alexander Winchell at its head, but the laboring oars were taken by Brooks on the iron bearing rocks, Pumpelly on the copper bearing rocks, and Rominger on the sedimentaries. Mr. Brooks' work introduced to the field a number of names prominent here and elsewhere, such as H. Credner, A. A. Julien, Chas. A. Wright, Regent C. D. Lawton, Jacob Houghton and others. It contains a valuable treatise on the tracing out of the stratigraphy of the very complicated iron regions by means of belts of magnetic attraction. It contains also a lot of microscopic descriptions which should mostly be replaced by later and more accurate work of the U. S. Geological Survey. In the field the distinction between the hornblende and augite was not satisfactorily made and the geological relationships of the rocks called diorites, which are largely altered augitic rocks was not understood. Nevertheless, in the matter of detailed stratigraphy of the iron bearing rocks, very great progress was made and a

mass of material regarding methods, mines and electrical relations has historical value.

Pumpelly with Credner,[11] who has been for years one of the most distinguished of the German Geologists, furnished much of the material for the description of the Menominee Iron Region, but it would be well before taking up the work in other fields to consider the progress of knowledge in the Marquette Range. This field is the earliest opened and most extensively studied, and has naturally been the Mecca for numerous geologists who intended to apply information collected here to other regions, and so we have references to the facts upon this range and inferences founded upon them, which depend upon first hand information and actual observation, very widely scattered in geological literature.[12] Our brethren in Wisconsin, Minnesota and Canada have certainly similar rocks and similar problems, a successful attack on one of which in one place will be likely to modify conceptions all along the line.

Among the rocks of the Archean we find coarse grained plutonic rocks, granites, syenites and peridotites which are mainly attributed to the lowest part of the formation,—the Laurentian of the earlier writers, a term introduced from Canada which I think we should still keep. In this lower group there are also gneiss and schists and possibly narrow bands of rocks like those above. The stratigraphic relations are of ineffable complexity and we have not begun to decipher them. Van Hise called them the Basement Complex and suggested that if there is such a thing visible, they may be part of the original crust of the earth. Above this Laurentian comes the iron bearing series proper, called the Huronian. Beside the familiar types of rock such as black slate, dolomite and quartzite passing into conglomerate, there are two important types which require especial attention. There are at first a lot of dark colored rocks composed of hornblende with more or less lime soda feld spar, chlorite and numerous other minor constituents. Instead of the hornblende there is often augite. The hornblende is in fact in most cases a product of alteration from the augite, though various authors have overlooked the augite entirely, and others have considered the hornblende, which some consider as secondary, as primary. There is also a question about this group of rocks as to whether they are stratified members or a series of sediments or igneous intrusives, and about the points just mentioned along and at times acrimonious difference of opinion has developed, beginning with Brooks and his assistants Julien and Wright and continuing through papers by Wadsworth, G. H. Williams and Van Hise, Smyth and Clements down to the present day. Personally I should summarize the matter as in the following paragraph and the U. S. Geologists would now, I believe, agree with me in the general conclusions, though we may still differ in specific applications.

There is a number of different types of the group of rocks above mentioned, most of which are undoubtedly igneous,—flows, intrusions or dykes in the iron bearing series and originally, mainly augitic. In the first place, it is relatively easy to cut out a group of dykes which cut through all members of the iron bearing series and whose augite is usually very little altered. They are the old feeders to the series of Copper-bearing Rocks and are subsequent to the formation and much of the distortion of the iron bearing series. Secondly, we have dykes which are similar, but cut by the former set, of a different prevailing strike,

whose augite is more altered, which may be considered as similar dykes of diabase, but coeval with some later part of the iron bearing series. Thirdly, we have masses of similar rock which is usually called diorite, along the cleavage or stratification of the iron bearing sediments. They are not infrequently the foot-wall of bodies of iron ore. In them the augite is generally very largely changed and sometimes instead of being a granular mass of hornblende and feldspar, popularly known as diorite, they become more uniform in color (greenstone) or are crushed and changed still further so as to be highly foliated and pass under the names of chlorite schists, soap stone, paint rock, etc. These masses were originally probably like the traps of New Jersey, and some of them intrusive like the Palisades of the Hudson and others effusive. The amount of secondary alteration makes the problem of determining which a difficult one, not yet systematically solved. Finally, in connection with the effusive sheets there are undoubtedly beds of tuff and sedimentary beds composed of altered trap fragments. I think there is no doubt that all these classes exist but some authors are inclined to see greenstone sediments everywhere and others to refer all doubtful cases to the igneous rocks. Some of these traps undoubtedly have altered the adjacent rocks as I have elsewhere remarked, and I believe a good deal of light will be thrown upon this matter by study of the effects of baking and contact metamorphism and the subsequent alterations. Little has been done in this line yet.

Another rather exceptional group of rocks are those in which some of the ore deposits occur, which have been called by Wadsworth, jaspilite,—a rock largely composed of silica. It bears a strong resemblance to some red porphyries or rhyolites and on account of that and some apparent igneous contact with schists, Dr. Wadsworth took it for an igneous rock and thus spoke of the igneous origin of iron ores. Perhaps all geologists are, however, now agreed that in the contacts spoken of, the apparently stratified and sedimentary schists are really the igneous rock and the jaspilite is the sedimentary. The greatest light upon the origin of the jaspilite has been thrown by Van Hise and Irving, who worked into the problem from the Penokee-Gogebic Range of Wisconsin and Michigan, where the stratigraphy is comparatively simple. Their theory, which is doubtless in large part true, is that the original rock of the jaspilite was a cherty iron carbonate. In limestones deposits of chert are very frequent and in the coal measures, beds of iron carbonate, known as black band iron ore, are of a well known type, so that there is nothing forced in the supposition made by Van Hise. We then have to suppose that these beds have been altered by the action of water and Van Hise has pointed out with great detail from the results furnished him by the engineers of many of the extensively exploited iron deposits that the iron ore rests in troughs made by impervious rocks, such as the soap stone above mentioned or slate, down which the waters percolate. The silica and carbonates have been removed and the iron ore concentrated. This concentration of iron ore bodies is, however, not confined to the jaspilite formation but occurs in several different horizons and particularly at the bottom of the formation whenever the structural conditions are favorable; for instance, often replacing the Goodrich Quartzite which lies at the base of one of the iron series.

This brings us to another question, that of the subdivision of the iron

bearing or Huronian series. Over this question there has been also a long controversy, participated in by various writers, and it cannot yet be said to be fully settled. I believe, however, that we are within sight of agreement on the great essentials. Mr. Van Hise is preparing a final monograph on the iron ores of Lake Superior, and I think that in that he will assume a position with which I can coincide in all the essential fundamentals. I copy from his report on the iron ore deposits of the Lake Superior Region in the Twenty-first Annual Report, a table slightly modified, the modifications which I have made being indicated by italics. It will be noticed that he has already introduced the possibility of sediments and iron bearing formations into the lowest division,—his Archean,—my Laurentian, which is a modification of his earlier position.

Cambrian	Lake Superior Sandstone.
(Unconformity)	
Upper Huronian, (Upper Marquette Series.)	Michigamme formation (locally replaced by Clarksburg volcanic formation). One might divide the Michigamme sedimentary formation into three parts: (a) upper slate member, (b) iron-bearing member, (c) lower slate member.
Rominger's Lake Hanbury?	Ishpeming formation, consisting of two members: the Bijiki schist (in western part of district), and the Goodrich quartzite, containing detrital ores at its base.
(Unconformity)	
Middle Huronian.	Negaunee formation. (The chief iron bearing formation.)
Rominger's Quinnesec?	Siamo slate, containing interstratified amygdaloid.
	Ajibik quartzite.
(Unconformity)	
Lower Huronian, (Lower Marquette Series.)	Wewe Slate.
	Kona dolomite.
Rominger's Norway?	Mesnard quartzite.
(Unconformity)	
(Laurentian.)	Granite, syenite, peridotite.
	Kitchi schist and Mona schist, the latter banded, and in a few places containing narrow bands of iron bearing formation.
	Palmer gneiss.

The iron bearing series and all three members of the Huronian have in many places been folded and a slaty cleavage produced which has been mistaken for the original bedding. They are probably least disturbed to the west in the Gogebic Range, where they occur in a fairly regular band with Laurentian rocks to the south and the Copper-bearing rocks to the north. Above them and generally unconformable come the rocks of the Copper-bearing series. Their distribution was fairly accurately outlined by Dr. Houghton and his assistants,—Burt and Hubbard—and it is summarized in the work of Foster and Whitney. Their mineralogical character was quite accurately determined by Koch and in fact, except for fine distinctions, is very simple. We have a series of flows of lava; the center massive, the top originally porous and full of bubbles which are generally filled in so as to produce a spotted appearance. The commonest minerals are augite and a lime-soda feld

spar. Olivine seems to have been frequently present but is generally altered. There also occur masses of more silicious rock, felsites and rhyolites. Usually one sheet is directly piled on another, but occasionally the igneous activity which poured them forth paused long enough to allow the formation of a small bed of sandstone or conglomerate. Toward the upper part of the formation as the igneous activity died out, the sandstones and conglomerates become more and more important until finally the top of the formation is almost entirely composed of red sandstone and shale. This is found on the south side of Isle Royal and on the south shore of Lake Superior west of Portage Lake. So much was early settled. Two or three points remain the subject of controversy and one of them is not yet settled.

We have said that the top of the formation is a red sandstone. Is this the same as or immediately beneath and earlier than the red sandstone which occurs around the east end of Lake Superior as the base of its Paleozoic there, and is of the Upper Cambrian Age, or is it separated by a long interval of time and unconformity, so that for it an age should be carved out beneath the Cambrian, to which the term Algonkian should be applied? To this question, no positive answer can yet be given. It remains for the future to decide and no fossils have been found or are likely to be found in such a great series of sandstone. On lithological grounds these sandstones have been given ages all the way from the New Red, down. The Minnesota Geologists attribute them to the Cambrian. The U. S. Geologists to the Algonkian. The Upper Keweenawan differs in a more basic character, a somewhat greater induration and, judging from the Freda Well, in salty water from the typical Potsdam or Lake Superior Sandstone. But on the other hand, the tendency to approach the Lake Superior Sandstone, both in lithological character and in structural conditions as we ascend in the Copper Bearing Series, is well marked. We have a great outpour of igneous rock beneath, a concomitant depression, the igneous activity dies out but the depression continues, and those parts of the igneous rocks which were exposed to erosion or eroded and form a sandstone. This epoch of depression seems to continue until the whole basin is swathed in sandstone, which is represented by the Lake Superior Sandstone. It is not to be expected that the upper part of this sandstone would contain so much trace of the igneous rocks. Now, when we find the upper part of the Keweenawan representing a depression and we find the upper part of the Cambrian also representing an era of depression, which might well be the continuation of the same, is there any good reason for supposing an era of time to intervene which shall represent at least the middle and lower Cambrian? Before we can fairly estimate the argument for the affirmative we must consider the second great question around which discussion so far the Copper Bearing Rocks are concerned has turned. The relations of the Keweenawan Copper Range to the rocks flanking in on the north are very simple. The beds all dip the same way and while there are minor unconformities, such as will be expected in a series of igneous rocks and is indicated by the pebbles and the conglomerate, still there appears to be no great break. On the south side of the Range, however, the relations are much more complex. There are two or three places where sandstone distinctly laps over onto the upturned edges of the Copper Bearing Rocks. There are other places, notably Douglass

Houghton Ravine, where the sandstones, generally called Eastern Sandstones, appear to dip directly and conformably beneath the Copper Bearing Series, although I think that in such cases a careful study of sufficient exposures will always show sign of faulting and that the contact is really made by an overthrust fault. Finally, there are other places which lend color to the view of Agassiz and Pumpelly, where the sandstone seems to abut against the trap range, as a conglomerate might against the cliff from which it was formed and finally there are numerous other places where the contact is plainly one of faulting and the beds of the Eastern Sandstones are variously crumpled. Into the details of the long controversy which has been the subject of a special bulletin (No. 23 of the U. S. G. S.) I will not go, but will merely state what I consider to be now proved and probable.

First, There is a large fault and smaller subsidiary faults running along the southeast side of the Keweenawan Range. There is no reason why slipping and disturbance on this plane may not have occurred from time to time down to at least as late as the stresses which produced a small sharp infold of Niagara and Trenton Limestone, in Limestone Mountain not far off. On the other hand it is certain that the disturbance there began before the end of the formation of the Eastern Sandstone which in some cases laps over on the disturbed strata. Not only that, but I consider it quite likely that the disturbance along this line began before the close of the Keweenawan and that the vents from which came some of the Keweenawan flows may have lain close to this line. It is not without significance in this connection that at Mt. Bohemia we find close to the fault line an old igneous plug which has altered the rocks which it has invaded.

Another question concerns the origin of the copper. Its association built in alternating layers of calcite and side by side with silver unalloyed, prove that it was laid down in a wet way. The association of copper with similar traps in a great many parts of the world leads one to look to them as in a broad way at least to the source of the copper. The olivine which is so largely decomposed sometimes contains small quantities of copper and nickel, and Pumpelly, without a doubt, ascribed the concentration of the copper to downward percolating waters which have decomposed the traps and concentrated the copper. In this I am inclined to agree with him, but Smyth looks to deeper seated hot waters for the source of the copper. The copper bearing formation is tilted and fractured but not contorted. The fractures that run across the formation are easy to detect but those which run with the beds are merely slipping of one bed upon another as the leaves of a book would slip when bent, or, have the same strike as the beds but a steeper dip, are very hard to detect. The progress in mining has, however, shown that they are very wide spread and slickenslides with chloritic walls are not at all uncommon. I think they guided the copper deposition. There is a theory among practical mining men that the copper occurs under high ground, and if this is true it will favor Pumpelly's theory, for the downward circulation would there be most active.

The third part of Vol. III is devoted to a further study of the sedimentaries of the eastern half of the Upper Peninsula by Dr. Carl Rominger, now a resident of Ann Arbor, who became and remained State Geologist for some twenty years. He added a good deal to our knowledge

of the paleontology of the belts, but did not materially change their distribution or subdivision, in fact, he was less inclined to minute division than Winchell. In Vol. III he transferred his studies to the Lower Peninsula, and this volume is a treasure house of observations upon the rock geology of the Lower Peninsula. One has to be thorough to find any rock exposures which he did not visit. He made also extensive collections of fossils, and the second part of the volume contains elaborately illustrated paper on corals. Dr. Rominger gives us not a few records of deep wells, and an appendix contributed by Dr. Garrigues calls attention to the different chemical character of the brines.[13] They also begin to appreciate how much thicker the geological column is than Winchell had been able to estimate from surface observations. Dr. Chas. R. Wright succeeded Dr. Rominger and when he died, leaving matters unfinished, I had to take up and prepare for publication the records which he had gathered during the great drilling excitement of 1885-7. This added a bundle of new facts which were incorporated in Part II of Vol. V, and my papers on the Water Supply of this State.

Little by little the drill, going down now for salt, now for oil or gas, now for water for the farm or city, or for mineral water, has added to our knowledge of the geology of the Lower Peninsula and enabled us to improve a little upon the boundaries laid out by the first geologists, yet in the main their work has stood the test of time. The main factor which is coming out is that there are minor flexures in the general basin like structure which was correctly found by the earlier Surveys. This shows in some of the cross sections given in my Coal Report. In regard to the salt, the following different brines may now be distinctly recognized:

1. The brine of the Parma Sandstone and the Grand Rapids Group, which is high in sulphates.
2. The brine of the Marshall Group, which is relatively free from sulphates but contains the earthy chlorides and valuable amounts of bromine.
3. The brine of the Berea Grit. This was perhaps first identified as such by Rominger in the old Ann Arbor well, but is also the source of the Huron County brines.
4. Brines of the Traverse and Dundee, the Devonian Limestones. Gas and oil are liable to be associated with these and particularly H_2S.
5. Beneath this comes the rock salt from which a brine is derived by letting down water from the surface.

There are of course other brines in Niagara and Trenton, but these are those of most commercial importance.

Much exploration has been carried on for oil and gas, but it has been very largely on the strength of surface deposits or signs and the results have been disappointing except near Port Huron. We have, however, beyond question the oil and gas bearing rocks, and it is only a matter of time when reservoirs of these substances in commercial quantities will be found.

While coal has long been known, it is only recently there has been much developed, and that material for correlation from other regions

has been obtained. It proves to belong to the Pottsville formation, formerly known as the Millstone Grit, the oldest in which workable beds occur.

The development of the Portland Cement Industry has recently spread to Michigan, and while drawn here first by deposits of marl, one of our surface deposits to be treated by another, I think it will be found that the State possesses limestones and shales which will be of great value to her in this connection.

In conclusion, as I have already given a brief summary of the formations below the Cambrian, I may give the rest of the geological column beginning with the Bay City Well and continuing with a new well at Port Huron, then taking up the Cheboygan Well, and then some of the wells along the Lake Michigan shore of the Upper Peninsula.

Coal Measures	380 plus	
Parma Sandstone	50	
Upper Grand Rapids	80	"
Lower Grand Rapids or Michigan	220	
Upper Marshall or Napoleon	130	
Lower Marshall	320	
Coldwater Shales	760	
Berea Shales	40	
Berea Grit	170	
	——	2,150

END OF CARBONIFEROUS AND BEGINNING OF DEVONIAN.

Antrim Black Shales	320	
Traverse Group (on St. Clair River)	296	
Dundee Limestone	129	
	——	745

END OF DEVONIAN AND BEGINNING OF SILURIAN.

Monroe beds, above salt formation	765	
Monroe beds with dolomite, salt, anhydrite	805	
Guelph and Lockport (Niagara) dolomites	600	
Rochester Shale	70	
Clinton	60	
Medina	142	
Lorraine and Utica	about 500	
Trenton	300	
	——	3,242
		——— 6,137

Calciferous has not been separated.

END OF SILURIAN BEGINNING OF CAMBRIAN.

The Lake Superior Sandstone has been bored at Grand Marais and at Lake Linden for over 1,000 feet with no important change.

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[2]Drummond Island, by S. F. Cook, Lansing, 1896.
[3]Publications of the Donglass Houghton Geological Survey.

Reports from 1838-1846 were published with Legislative documents as follows: S. D. means Senate documents; H. D. House documents; J. D. joint documents. State Geologist is abbreviated S. G., and State Geological Survey, S. G. S.

1838. Report of a select committee of the Board of Regents of the University on the collection of the S. G.
H. D. Vol. I, p. 1-2; S. D. No. 1, p. 1. H. D. No. 5 is duplicate of No. 1.
Statement of the expenditures on account of S. G. S. for the year 1837.
H. D. No. 8, pp. 115-118; S. D. No. 21 (First annual account of the S. G.), pp. 315-318.
Report of the S. G. (first annual).
H. D. No. 24, pp. 276-317; S. D. No. 16; separately, No. 14, pp. 1-39.
Communication from the S. G.
H. D. No. 46, pp. 457-460.

1839. Report of the S. G. in relation to the improvement of State Salt Springs.
H. D. No. 2, pp. 39-45; S. D. No. 2, pp. 1-8.
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H. D. No. 4, p. 123.
Report of the S. G. in relation to the iron ore, etc., on the school section in town five south, range seven west, in Branch county.
H. D. No. 21, pp. 342-344.
Second annual report of the State Geologist.
H. D. No. 23, pp. 380-507; S. D. No. 12, pp. 364-391; also separately H. R. No. 23, and S. R. sometimes misprinted No. 13 and No. 23, pp. 39, and appendix of sub-reports 123 pp.
Report of the Committee of the Senate on Manufactures, to whom was referred the communication of the S. G. relative to salt springs and the salines of the State.
S. G. No. 3, pp. 85-86 (parallel to H. D. No. 4).
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H. D. No. 2, Vol. I, pp. 18-23; S. D. No. 8, Vol. II, pp. 153-158.
Annual report of the State Geologist (third, map of Wayne county).
H. D. No. 27, Vol. II, pp. 206-293; S. D. No. 7, Vol. II, pp. 66-153; separately No. 8, pp. 1-124.
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H. D. No. 46, Vol. II, pp. 455-461.
Report of the majority of the Committee on Finance on the communication and accounts of the S. G. for 1839.
Report of the minority of the Committee on Finance on the same subject.
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S. G.'s account for the year 1839, the same being the subject matter of the three preceding reports.
S. D. Nos. 15, 16, 17, 18, pp. 209-224.

1841. Special message concerning State Salt Springs.
H. S. and J. D. No. 5, pp. 235-254.
Annual report of the S. G. (fourth).
H. S. and J. D. No. 11, pp. 472-607; separately H. D. No. 27, pp. 1-184.
Report of the S. G. relative to county state maps.
H. D. No. 35, pp. 94-98.

1842. Report of the S. G. relative to the State Salt Springs.
H. D. No. 2, pp. 15-21; S. D. No. 1, pp. 1-9.
Report of the select committee in relation to the report of the S. G.
H. D. No. 19, pp. 77-79.
Annual report of the S. G. (fifth).
J. D. No. 9, pp. 436-441.

1843. Annual report of S. G. (sixth).
J. D. No. 8, pp. 398-402.
Report of the S. G. relative to the State Salt Springs.
S. D. No. 9, pp. 402-408. Maps of Washtenaw, Calhoun, Jackson and Lenawee Counties were published separately.

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D. Houghton undertook an arrangement with the Linear Survey of the U. S. Land Office by which a certain amount of geological work was done, which was never published by the State, the results of which appear largely in the township plats of the Land Office, and in the report of C. T. Jackson, 1849, U. S. S. Ex. Doc. No. 1, pp. 371-935. H. Ex. Doc. No. 5, Part 3, including sub-reports of W. A. Burt and Bela Hubbard on the geology of the sub-divisions of the Linear Survey, First Session 31st Congress, and of Foster & Whitney, U. S. Geologists, Part I, II, Ex. D. No. 69, pp. 1-224 and 12 Plates, First Session 31st Congress; S. Ex. D. No. 2, Vol. 2, p. 147, Second Session 31st Congress; Part II S. Ex. D. No. 4, Vol. 3, p. 3, Special Session 32d Congress.
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[4]p. 125 of the Fourth Annual Report above cited.

[5]Vol. VI—Studien des Göttingenschen Vereins Bergmännischen Freunde, Parts I and II, July 18, 1852; "Die Mineral Regionen der obern Halbinsel. Michigan's (N. A.) am Lake Superior und die Isle Royal," by Fr. C. L. Koch.

[6]Voyage au Lac Superior.—par M. L. R. Rivot, Extrait des Annales des Mines, tome VII, p. 173, Paris, Victor Delmont, publisher, 1855.

[7]1861. First biennial report of the progress of the G. S. of M. Embracing observations on the Geology, Zoology and Botany of the Lower Peninsula. Made to the Governor, December 31, 1860.

[8]Issued and reissued in various shapes and the standard material for geographers, between 1864 and 1873. At the latter date, they were issued in a separate book entitled, "Michigan" being condensed Popular Sketches of the Topography, Climate and Geology of the State, 800, pp. 121, 8 lithographic and four colored charts.

[9]See report on Huron County, pp. 14 to 23, pp. 252 to 291; also bibliographies in U. S. Geological Survey Bulletin, No. 80.

[10]Outlines of a Proposed Final Report of the Survey of the State of Michigan, to be made in pursuance of an Act, approved March 26, 1869.

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1873. Vol. I. Upper Peninsula, 1869-1873. Accompanied by an Atlas of maps. Edition 2,000.

Part I. Iron Bearing Rocks (Economic), T. B. Brooks. Of this an extra edition of 500 with thirteen accompanying atlas plates was issued.

Part II. Copper Bearing Rocks, Raphael Pumpelly (Plates 14, 14a, 15-23 of the atlas accompanying; Chapters IV, VII, VIII are by A. R. Marvine).

Part III. Palæozoic Rocks, Dr. C. Rominger. (Plate 24 of the atlas accompanies. There was an extra edition of 500 dated 1872, without map or index, differing slightly in title page, introduction and paging).

Vol. II. Upper Peninsula. 1869-1873, appendices to Part I, Vol. I. A. Lithology by A. A. Julien, B. Lithology by T. B. Brooks and A. A. Julien, C. Lithology by Charles E. Wright, D. Ore deposits, E. Lithology (Notes by D. Houghton), F. Iron ore docks by Jacob Houghton and Chas. H. Palmer, with Plate XX). G. Census statistics (1870), H. Magnetic Analyses (by F. B. Jenney), I. Mining laws (by C. D. Lawton), J. Metallurgical qualities by H. B. Tuttle, K. Contortions of Laminæ (by T. B. Brooks).

[11]H. Credner. See his geology and papers in various German geological Journals, abstracted in Monograph 46 of the U. S. G. S.

[12]E. g. N. H. Winchell in the Geological Survey Reports of Minnesota, McFarlane and Coleman and others in those of Canada; Brooks, Wright Irving, VanHise, Grant and others in those of Wisconsin, beside the U. S. Geological Survey Reports below referred to.

[13]See also papers by H. C. Hahn in the Berg-und-Huettenmaennische Zeitung, 1866, and the U. S. Geological Survey Water Supply paper, No. 31.

In bulletin No. 177 of the U. S. Geological Survey is given a full catalogue and index of the publications of the U. S. Geological Survey pertaining to Michigan, from 1880 to 1901. Monographs V, on the Copper Bearing Rocks; XIX on the Gogebic District; XXVIII on the Marquette District; XXXVI on the Crystal Falls District; XLVI on the Menominee District; Bulletins 23, on the Keeweenaw Fault; 62 on the Greenstone Schist Areas. Water Supply Papers Nos. 30 and 31 are wholly or largely devoted to Michigan.

The more recent publications of the State's Survey are described in circulars issued by them.

ABRAM SAGER, A. M., M. D.

Abram Sager was born at Bethlehem, Albany county, New York, December 22, 1810. In 1831 he was graduated from the Rensselaer Polytechnic Institute at Troy, New York, in which he had spent two years as pupil and instructor. While at this institution he was under the instruction of Professors Torrey and Eaton, men of note in the fields of botany and zoology. Their influence and guidance did much to direct his attention to these subjects. It may be stated that on the death of Professor Eaton, Dr. Sager was tendered the presidency of the Rensselaer Polytechnicum, but found it necessary to decline. Later, Dr. Sager continued his studies at Albany and at New Haven, Connecticut. At the latter place his work was done under the supervision of Professors Marsh and Ives, names well known to American science. He graduated in medicine at Castleton, Vermont, in 1835. After graduating in medicine Dr. Sager came to Detroit and engaged in general practice. In February, 1837, Governor Mason approved an act for the organization of a geological survey of the State of Michigan. It provided for a geological, zoological, botanical, and topographical survey. Under this act Dr. Sager was placed in charge of the Botanical and Zoological Departments. The second annual report of this survey contains a paper entitled, "A Systematic Catalogue of the Animals of the State, so far as Observed," by Dr. Sager.

In 1842 Dr. Sager assumed the duties of Professor of Zoology and Botany in the University of Michigan, and he continued in this chair until 1850, when, upon the organization of the Medical Department, Dr. Sager's work was transferred to the new department. The positions which he held in the State University may be summarized as follows: He was professor of Zoology and Botany, from 1842 to 1850; professor of Obstetrics, Diseases of Women and Children, and professor of Botany and Zoology, from 1850 to 1854; professor of Obstetrics, Physiology, Botany and Zoology, from 1854 to 1855; professor of Obstetrics and Physiology, from 1855 to 1860; professor of Obstetrics and Diseases of Women and Children, from 1860 to 1875. He prepared and presented to the University a herbarium containing about 1,200 species and 12,000 specimens. He collected and prepared many zoological preparations, and these constituted the nucleus of the present University Museum. He also prepared many specimens illustrating Comparative Neurology, Embryology and Craniology. In addition to the above he made and presented to the University a large collection of parasites found in man and other vertebrates and these are still to be found in the Pathological Museum.

While in general practice in Detroit he published an article on American Amphibia, which was translated and republished in German. In this article the author treats of the generic value of the arrangement and location of teeth in amphibia and describes more fully certain American salamanders, noting several new species. He also reported several zoolog-

DR. ABRAM SAGER.

ical papers which are to be found in the proceedings of the Academy of Natural Sciences of Philadelphia. His strictly medical contributions are not numerous, but are of considerable value, and they are worthy of reading and of emulation on account of their conciseness, clearness and purity of diction.

Dr. Sager was a member of the American Association for the Advancement of Science, of the Academy of Natural Sciences of Philadelphia, of the Academy of Sciences of New Orleans, of the Academy of Sciences of Chicago. He was one of the first of the Michigan physicians to become a member of the American Medical Association; he was a member of the New York State Medical Society; of the Michigan State Medical Society, and of the Obstetrical Society of Philadelphia. His modesty and retiring disposition were incompatible with his becoming a prominent factor in any of the societies in which he was a member. It is said that when present at any such gathering, he was usually found occupying an inconspicuous place in the rear of the room, few members being aware of his presence.

In 1875 he obtained leave of absence from his university duties and spent the winter in Florida and South Carolina, returning in the spring temporarily relieved from his physical disability and looking forward to several years of active labor. These hopes were, however, not realized, and in 1874, on account of his illness, he found it necessary to lay aside the harness which he had worn so long, giving up all attempts at teaching.

The Regents conferred upon him the title of emeritus professor, and he remained as Dean of the Medical Faculty until June, 1875, when he felt obliged to sever all connection with the University. He developed Bright's disease from which he died August 6, 1877.

One of his colleagues (Dr. Breakey) thus speaks of Dr. Sager:

"His life teaches us that the success and fame most desired and enduring are achieved by straightforward, honest means, and by persistent effort; that devotion to truth, to scientific research, to the development of rational medicine without pretentiousness, without quackish art, with fidelity to obligations, brings its rewards in the esteem and commendation of professional brethren, the confidence and honor of the public, and the gratitude of patients."

V. C. V.

CORYDON L. FORD, M. D., LL. D.

Dr. Ford was born of good Puritan stock in Greene county, New York, August 29, 1813. His father was a farmer, but infantile paralysis of one of his lower limbs rendered the youth unfit for the severe manual labor of the agricultural pioneer, and gave him more time for study. At the early age of seventeen he began his life-work of giving instruction to others. As a schoolmaster, he very soon developed that clearness and terseness of statement, enthusiasm in his work, and close sympathy with his students, which afterwards made his lectures veritable revelations to the many who attended them in search for knowledge. A good foundation for professional studies was laid at the Canandaigua Academy, and in 1842 the degree of Doctor of Medicine was earned at the Geneva Medical College. Dr. James Webster, then professor of Anatomy at Geneva, was noted for his skill in dissecting, his success in demonstrating, and his fluency in lecturing. Of this able teacher young Ford became, during his course of study, the favorite pupil; and on the day of his graduation he was appointed demonstrator of Anatomy. In 1846, Flint, Hamilton, White, Webster and Ford, all names now memorable in the history of medical education in this country, established the Medical College at Buffalo. In 1854 Dr. Ford was called to the professorship of Anatomy in the University of Michigan, and here he labored continuously for forty years. From 1854 to 1886, he gave a second course of lectures, and sometimes a third, in other schools during the spring or summer months: At Castleton, Vermont, until 1861; in the Berkshire Medical College, at Pittsfield, Massachusetts, from 1860 to 1867; in Bowdoin College, from 1864 to 1870; and in Long Island College Hospital, Brooklyn, from 1868 to 1886. By thus giving two or more courses in different schools in the same year, Dr. Ford finished his one hundred and ninth course of lectures in Anatomy the day before he was stricken by death.

Probably no other professor, certainly no other professor in a medical school in this country, has given instruction to so many students, and it can also be said that no other teacher has won more of the respect, confidence, and love of his pupils. Thousands have sat at his feet, have seen him make the dry bones objects of interest, convert the shriveled muscles into volumes of information, and cause the dead to teach the living how to heal the sick.

Dr. Ford gave all his time and energy to teaching, and as a consequence contributed but little to the literature of his chosen science. However, he made extensive notes, and it is likely that among these there may be found records of valuable scientific facts. As a great oral teacher, a class not numerous in these days when hand-books, text-books and compends are produced so abundantly, he will be remembered and revered by his students. In recognition of the great service he rendered in building up the Medical Department of Michigan University, Dr. Ford was honored with the degree of LL. D. in 1881. It is not generally

DR. CORYDON L. FORD.

known, but it is true, that Dr. Ford was a surgeon of ability and of no little skill, as well as an anatomist. His perfect knowledge of the relations of the different tissues in every region of the body made his advice and assistance to the general practitioner, who, when called upon to do a surgical operation often finds his knowledge of anatomy less extensive than he had supposed, of the greatest service, and in western New York he was often called, not only to advise and assist, but to do the operation. He ligated some of the larger arteries a number of times, reduced fractures and made amputations.

After coming to Ann Arbor Dr. Ford was not called upon to do much surgery until Dr. Gunn went to the front as an army surgeon, and during this time Dr. Ford did all the operations at the surgical clinic. The late Dr. Skene, of Brooklyn, New York, who was a student in the University of Michigan at that time, has testified to the fact that Dr. Ford handled the knife with equal judgment and skill as an anatomist and as a surgeon. Dr. Ford died at his residence in Ann Arbor April 14, 1894, of cerebral apoplexy. He had given his last lecture of his fortieth year of service in the Medical Department of the University only two days before he passed away. V. C. V.

VARIATION AND CORRELATION IN THE EARTHWORM.

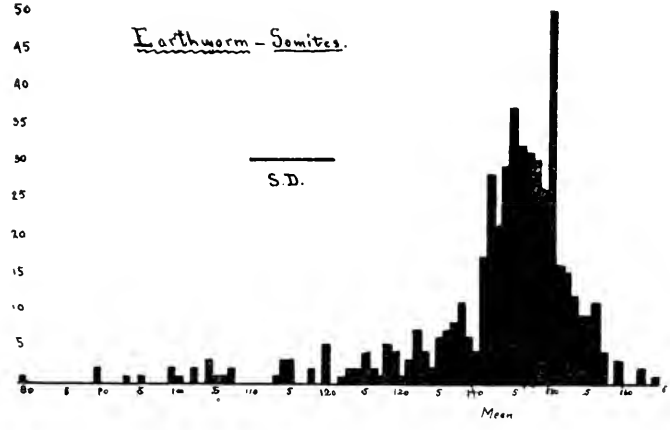
RAYMOND PEARL AND WILBUR N. FULLER.

(Abstract.)

A statistical study of variation in the common earthworm, *Lumbricus agricola* Hoffm., included the following characters:

I. The total number of somites in the body.
II. The total length of the body.
III. The number of somites from the anterior end of the worm to the clitellum.
IV. The number of somites in the clitellum.

The worms measured were all collected from a restricted area in the city of Ann Arbor. The collection was entirely at random. Only those individuals were measured which were sexually adult, and consequently bore a clitellum.



EXPLANATION OF FIGURE.

FIG. 1. Frequency polygon of variation in the number of somites in the body of the common earthworm. Abscissæ, number of somites; ordinates, number of individuals. S. D. = Standard deviation.

The polygon of frequency, showing the variation in the total number of somites in the body, is shown in Fig. 1. The constants for this polygon are given in the following table:

Mean	142.71 somites.
Standard Deviation	11.85 "
Coefficient of Variation	8.31 %
Number of individuals	487
Range	79–164 somites.

The point especially to be noted here is the great range of variation and the rather high variability as measured by the standard deviation and the coefficient of variation.

The constants of the frequency distribution for variation in the length of the earthworm are:

Mean	19.17 cms.
Standard Deviation	3.08 "
Coefficient of Variation	16.05%
Number of individuals	487
Range	11.25—28.75 cms.

It is seen from this that the earthworm is markedly more variable in length than in number of the somites in the body, as measured by the coefficient of variation in both cases. A portion of this difference is undoubtedly due to the fact that length is a character very difficult to measure accurately in the case of the earthworm.

The constants for the variation in the number of somites from the anterior of the worm back to the anterior end of the clitellum, are given in the following table:

Mean	30.76 somites.
Standard Deviation	.43 "
Coefficient of Variation	1.41 %
Number of individuals	495
Range	29—32 somites.

The markedly lower variability in this character (1.41 per cent.) as compared with the total number of somites and the length, is noteworthy.

The number of somites in the clitellum was found to vary between six and eight. The constants of the frequency distribution are

Mean	6.24 somites.
Standard Deviation	.50 "
Coefficient of Variation	8.02 %
Number of individuals	495

It is of interest to note that the clitellum is decidedly more variable with respect to the number of its somites than is the body in front of the clitellum.

The correlation between the number of somites *in front of* the clitellum and the number *in* the clitellum was studied. The value of the coefficient of correlation in this case was

$$r = -.629.$$

This result is of considerable interest, since it shows that as the number of somites in front of the clitellum *increases* there is a strongly marked tendency for the number of somites in the clitellum to *decrease.*

The possible significance of the normal existence of negative correlation for problems of morphogenesis was discussed. The suggestion was made that possibly negative correlation might have ultimately the same physiological basis as compensatory regulation.

The value for the coefficient of correlation between total length and total number of somites in the earthworm was found to be

$$r = .260.$$

This indicates a rather low degree of correlation between these characters.

The complete paper, of which this is an abstract, will appear in another place.

VARIATION AND CORRELATION IN ARCELLA.

RAYMOND PEARL AND FRANCIS J. DUNBAR.

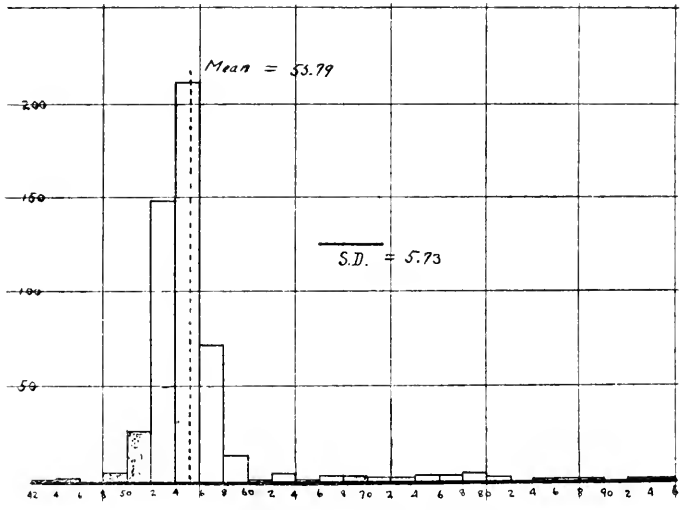
(Abstract.)

The results of a statistical study of the variation of the shell of the common *Arcella vulgaris* with respect to the following characters were presented: (a) Total diameter of shell (="outer diameter"), (b) diameter of opening in shell (="inner diameter"), (c) color of shell.

The constants of the frequency distributions for outer and inner diameters are given in the following table:

Constants.	Outer Diameter.	Inner Diameter.
Mean	55.7897 ± .1721 mikrons	15.9107 ± .0653 mikrons
Mode	52.5635 "	15.0357 "
Median	54.7143 "	15.6190 "
Standard Deviation	5.7283 ± .1217 "	2.1731 ± .1462 "
Coefficient of Variation	10.2676 ± .2294 %	13.6578 ± .2955 %
Number of indivlduals	504	504
Range	42—96 mikrons	11—40 mikrons

The frequency polygon for the outer diameter variation is exhibited in Fig. 1.



EXPLANATION OF FIGURE.

FIG. 1. Frequency polygon of variation in outer diameter of *Arcella vulgaris*. Abscissæ, dimensions in mikrons; ordinates, number of individuals. S. D. = Standard deviation.

Arcella was shown to be approximately equal in amount of variation to Paramoecium. The values for Paramoecium were determined by Simpson.*

The relations between the values of the coefficient of variability in the two cases are shown in the following table:

COEFFICIENT OF VARIATION.

Paramœcium.		Arcella.	
Length	8.361 %	Outer diameter	10.268 %
Breadth	13.439 %	Inner "	13.658 %

The correlation in variation between the outer and inner diameter was discussed. The correlation table and a model of the correlation surface were exhibited. The value of the coefficient of correlation between these two characters, outer and inner diameter was

$$r = .836$$

showing a comparatively high degree of correlation in this simple rhizopod. The value of the coefficient of the correlation between the length and breadth of Paramoecium (Simpson, loc. cit.) is .421. Correlation is much closer in the firm, definitely formed shell of Arcella than in the body of Paramoecium.

*Simpson, J. Y. The relation of Binary Fisson to Variation. Biometrika. Vol. I, pp. 400–464. 1902

The correlation between color and size (as expressed by the outer diameter) in Arcella shells was studied. The value of the coefficient of correlation in this case was

$$r = .012.$$

This is a very low value and indicates that there is practically no correlation between color and size in Arcella shells, within the size limits of the series of shells studied in this work.

A full discussion of these results has appeared elsewhere.

DAIRY INSPECTION.

C. E. MARSHALL, AGRICULTURAL COLLEGE.

From the many sided discussions of this subject we obtain our excuse for presenting our views. Too much is thoughtlessly said, too much comes from a prejudiced standpoint concerning it, and too little of its fullest significance is realized. Narrow views emanate largely from those who would step into the position of dairy inspector and conduct the work in a very incomplete manner as dictated only by their limited knowledge. Perhaps the ignorance prevailing concerning the various phases of milk inspection is accountable for this reliant spirit, yet it is true that circumstances of this nature must not control such a vocation as milk inspection because in it there is too much involved. The veterinarian on the one hand and the medical man on the other frequently seek out this position in the municipal government as thoroughly competent applicants. They do possess certain qualifications belonging to the vocation of dairy inspector, it must be admitted, but, as we shall see later, a practical milk producer perhaps has as many qualifications as either the veterinarian or the medical man.

Whenever one of these various individuals, veterinarian, physician or dairyman, undertakes to perform the duties of this office, its functions immediately turn into the channel well known to the individual. The inspector becomes one sided and the result is that the functions are carried out improperly and only in part. The work of dairy inspection should be placed upon a broader basis, upon a professional basis, and the boundaries should be extended so as to include all parties interested in milk problems. If this is done, it means that it is sufficiently wide in its scope to be recognized as a distinct profession in itself. It is commonly admitted that dairy inspection is very imperfectly executed and it may be doubted whether at present it is a success at all. Certain knowledge is called for, possessed by no specialist; whether he be physician, veterinarian, chemist, bacteriologist, dairyman or stockman, it matters not. Only one individual presumes to know all the details of dairy inspection, this person is the omniscient ward politician.

First of all and most important are the two distinct sides which constantly hector the milk inspector, that of milk production and milk consumption. It devolves upon the inspector to harness these two sides in harmonious operation. To do this an intimate acquaintance with the nature and peculiarities of each is absolutely essential. As is usually the case it is rare to find an inspector who is thoroughly conversant with a single side. To stand in a peremptory manner and command or demand what should be done on one side or the other, even going so far as to enact laws to control, must always be farcical; for does it not seem incredible and impossible to compel the correct production of milk when the ways of escape are so numerous? Commands, demands, laws, therefore, amount to nothing other than the donning of rich garments on a

filthy body. They serve as shrouds to cover, but not as water to clean. To succeed in obtaining good milk from the producer and a suitable return from the consumer, there must be the utmost harmony of action and the greatest sympathy should exist on the part of the inspector. A continuous struggle between consumer and producer scarcely ever results in a better product or in progress. If the inspector can enter into the details of each side and adjust the details of one side into those of the other, there will then exist a united pull which indicates onward growth. This, of course, means that the inspector must be uninfluenced by politics, by prejudiced opinions, by personal friendships, and that he must stand out in every sense a man, trained in his vocation.

Some course of training is demanded if the preceding has any foundation. The time required for this training will depend upon the previous preparation of the individual. If I were to offer a scheme, I should place the work under two headings:

1. *Dairy Methods.* (a) Practical. All those operations which are included in the handling of milk from the time it leaves the cow until it reaches the consumer, either in the form of milk, butter or cheese.

(b) Scientific. All those methods which are necessary to know, in the detecting of the various constituents of normal milk or any deviations from the normal. This would include a course in bacteriology, chemistry, hygiene, and perhaps other knowledge.

2. *Animal Husbandry.* By this I mean a thorough knowledge of physiology and anatomy of the animal, of the hygiene and care of the animal, of breeds and breeding, of feeds and feeding, and of the common contagious diseases.

It might be pertinent to insert coördinately another heading, distinct from the other two, indicating a knowledge of the common infections diseases of man, but it has seemed to me that it would be most practicable to insert this point under the previous two.

It is difficult to conceive of an inspector demanding of a producer a product when he himself is unable to say how it may be produced and which the producer himself, nine times out of ten, does not know how to produce. By our bacteriologic methods at the present time, it may be easy to tell the producer that he is not handling his milk correctly, but how different it is to tell him where the trouble lies and how to rectify it. Dictatorially the inspector may say that the milk must be cleaner; yet does the inspector himself know what dairy cleanliness is? Then how may the producer be expected to emerge from darkness into light without any guide? Without a knowledge of cooling, of aërating and the various methods employed, how can the producer, when the inspector is of no assistance, know how to better his condition and at the same time maintain his financial status by so doing. These differences may be easily illustrated to any individual by taking him to a well managed dairy on a paying basis and one that is poorly managed. This, however, would be simply an illustration and it is for the inspector to point out the differences which make the well managed successful and the poorly managed dairy unsuccessful.

After reviewing what is possible with an inspector, the courses of study which he should follow in connection with dairy methods are at once determined and fall in line with those indicated above. With the

readers acquainted more or less with these subjects a simple discussion of them will suffice. They are microscopy, chemistry, bacteriology, hygiene, and physics of milk. With these he should be practically and scientifically familiar. The dairy methods with which the inspector should equip himself are therefore the practical daily operations of the dairy and the scientific studies underlying them.

Farther than this, a sufficient knowledge of animal husbandry should be obtained to be of practical import. The animal which produces the milk is no small factor in the quality of the milk produced. To understand how that animal may influence the milk supply, should be within the best knowledge of the inspector. What the richness is, what the quality is, what the amount of the milk is coming from any individual cow, all these points are essential to a comprehensive study in the production of milk,—for such points determine whether an animal is profitable or unprofitable. To answer these questions, besides a knowledge of the foregoing studies mentioned, it would be necessary to determine how the feeds and feeding, the breeds and breeding may be influencing the production of milk. Such knowledge calls for a special line of study. Besides all of this there should in all of the work be that constant supervision of the diseases, both among animal and man (infectious especially), which in one way or another may be conveyed in milk. The inspector should always be cognizant of all infectious diseases prevailing upon the farms of milk producers or in the families of the consumers and should at once employ every means to shut off the various avenues of dissemination. This is a very important part of the inspector's duties and it is where the veterinarian and the physician have their hold on milk inspection in spite of their ignorance of the other classes of knowledge necessary.

It follows that in these days of specialization, when every special field is sufficiently broad for any man, and many times too broad, the vocation of milk inspector is important enough to be set aside by itself as distinct and to be taken out of the political realm and made a professional office.

One other thought I wish to add to the above discussion, notwithstanding the fact that it is not eminently applicable in this connection. The adjustment of prices is a matter well within the business tact of the inspector. The consumer does not know what it costs to produce a quart of milk of any quality, say nothing of diverse qualities. There is usually a constant demand for better milk, but such demands should be met with an intelligent answer of the cost of production. If a man wants four-cent milk, let him have it, but if he demands a better grade and is willing to pay eight cents, he should receive the full value of his money. The inspector ought to be able to name the milk-men impartially who are furnishing the different grades and why certain prices stand for these grades. By so doing as an honest man he will serve his community faithfully and well, including milk producers and consumers.

STUDIES IN DENITRIFICATION.

S. F. EDWARDS.

Denitrification is, as the term implies, a reducing process in which the nitrogen of the soil is eliminated in one form or another by the breaking down of the nitrate or complex nitrogenous compounds, thereby becoming lost to plant growth. It is still to a great degree an open question in what form the nitrogen is lost, whether as oxides of nitrogen, free nitrogen or free ammonia, or in more than one of these forms.

The denitrification phenomenon was first noticed in cultivated soil in 1862 by Goppelsröeder, and for a long time it was regarded as a purely chemical process. The first reference to the agency of bacteria in the changes produced was made in 1875 by C. Meusel, and the earliest pure cultures of such micro-organisms were made in 1882 by U. Gayon and G. Dupetit. In 1886 W. Heraeus made known several species of the denitrification class and two years later Percy Frankland and R. Warington found a large percentage of soil bacteria capable of reducing nitrates to nitrites although they do not state whether their cultures possess the power of further reduction.

In later years scores of workers have entered the field, and, working upon different phases of the subject have secured some very valuable results.

The object of our investigation was to contribute something toward a solution of the problem by a detailed study of the denitrifying properties of three germs found commonly at a depth of two to six inches in different soils upon the farm at Michigan Agricultural College, viz.: Bacillus subtilis, B. megaterium, and B. mycoides.

A brief outline of the investigation pursued follows:

1. Action upon nitrate.
2. Action upon nitrite.
3. Action upon ammonium salt.
4. Effect of the presence of organic matter.
5. Influence of abundant oxygen supply.

1. Action upon Nitrate.

As has been stated, in 1888 Franklin and Warrington found a large number of soil bacteria capable of reducing nitrate to nitrite, but leave no record of further products. In our work an endeavor was made to determine quantitatively the reduction of nitrate to nitrite, and whether any further products resulted. The culture solution used contained, besides the potassium nitrate which formed its basis, the other elements necessary for plant growth in various salts, and a small amount of organic matter in the form of peptone.

Seventy-five c. cm. Erlenmeyer flasks, plugged and sterilized in dry heat, received twenty-five c. cm. of the culture solution and were sterilized intermittently in moist heat. The inoculations were made with .5 c. cm. of cultures of the germs in a mineral solution containing a mini-

mum of nitrate or organic matter, some of the flasks being retained uninoculated for controls. The cultures were kept in a darkened room at an average temperature of twenty-five degrees C. In all the work with mineral solutions bouillon tubes were inoculated with small portions from the culture and control flasks to verify the vitality of the cultures and sterility of the controls. Determinations of nitrite and free ammonia were made at the time of inoculation and at intervals thereafter.

TABLE I.

Nitrites expressed in grams per litre of N_2O_3.

Ammonia expressed in grams per litre of NH_3.

	At inoculation.		At two days.		At seven days.		At sixty days.	
	N_2O_3	NH_3	N_2O_3	NH_3	N_2O_3	NH_3	N_2O_3	NH_3
B. subtilis	None	None	None	.0099	.1433	.016	.264	.0064
B. megaterium	None	None	None	trace	.2576	.0224	.4198	.0064
B. mycoides	None	None	.033	.016	.033	.0224	.0882	.0128
Uninoculated Control	None	None	None	None	None	None	None	None

The theoretical amount of N_2O_3 per litre of the original culture solution from KNO_3 equals 3.762 grams. The amount of NH_3 per litre from the KNO_3 of the culture solution equals .841 grams. The results show a steady increase in the amount of nitrite as the cultures become older. The amount of ammonia shows a decrease at the time of the last test, a phenomenon which may be accounted for by the gradual degradation of the ammonia compounds formed, and the liberation of free nitrogen, a question which at present remains unsettled.

A. Do the Nitrites and Free Ammonia Result from the Breaking Down of the Nitrate or the Peptone?

Upon examination of the results of Table I., the question arose whether at least a portion of the nitrite and free ammonia might not be products of the analytical destruction of the peptone. To settle the point, a solution was prepared which was identical with the previous one with the exception that no nitrate was used, and the cultures were handled in exactly the same manner. The results are shown in Table II.

TABLE II.

Nitrites expressed in grams per litre of N_2O_3.

Ammonia expressed in grams per litre of NH_3.

	At inoculation.		At two days.		At seven days.		At sixty days.	
	N_2O_3	NH_3	N_2O_3	NH_3	N_2O_3	NH_3	N_2O_3	NH_3
B. subtilis	None	None	None	.0121	None	.0194	Trace	.0048
B. megaterium	None	None	None	None	None	.0242	Trace	.0291
B. mycoides	None	None	None	.0048	None	.0291	.011	.0194
Uninoculated Control	None	None	None	None	None	None	Trace	None

From a comparison of the tables the fact becomes evident that most of the ammonia in the nitrate cultures results from the degradation of

the peptone. No reaction for nitrites was obtained until the cultures were old and then only a trace. Whether this was due to spontaneous chemical changes is a question. The fact that the control, which remained sterile, showed a trace of nitrite would lead one to suspect that such was the case. The work was duplicated in order to verify it and the same results were obtained. These results agree with Maassen (Cent. f. Bakt. 1902 II No. 5. S. 152) who grew 109 common bacterial species in a mineral solution containing peptone, and who says in stating his results; "Considerable ammonia was also produced on account of the vigorous peptonization."

2. Do the Micro-Organisms Have a Reducing Action upon Nitrites?

To determine whether the micro-organisms were capable of reducing nitrites a nutrient mineral solution having nitrite for its basis was prepared, and cultures were made and handled in the same manner as in the previous work. Tests were made at various intervals, but in only one case, B. mycoides, was any decrease in nitrates apparent.

3. Action of the Organisms upon Ammonium Salt.

Cultures were made in a nutrient mineral solution having for its basis ammonium sulphate, and Nessler determinations were made at intervals to discover, if any, the decrease in the amount of ammonia. Duplicate tests were made at different periods, the results of which corresponded. At no time was any change observed in the ammonia content, showing that these bacteria have not the power of reducing ammonium sulphate, and furthermore that this salt prevented the production of ammonia from the peptone which was present in the solution.

4. The Effect of the Presence of Organic Matter upon Denitrification.

Künneman, a German investigator, in 1898, in experiments carried on with a micro-organism which he had isolated from horse dung, found that the amount of denitrification decreases as the amount of organic matter increases, which observation was also made by Matz and Wagner, who stated that as "humification" proceeds, the power of destroying nitrate decreases. On the other hand, Pfeiffer states that denitrification can take place only in the presence of straw, feces or vegetable tissue which act as food substance for the denitrifying organisms. Stutzer and Maul isolated two micro-organisms which gave very marked nitrate reducing power when grown in a solution containing a small amount of organic matter. Maassen states that in a strictly inorganic solution he obtained very little reduction of nitrate by common bacteria. In our studies along this line five solutions were used, differing only in the nature of the material furnishing the combined nitrogen to be acted upon, the basis of the different solutions being as follows: Ammonium nitrate and Potassium nitrate, Asparagin, Potassium nitrite, and Potassium nitrate and nitrite combined in equal amounts. The other elements necessary to plant growth were added in various salts, but none of the solutions excepting the asparagin contained any organic matter. The cultures were tested at the end of forty-five days for the reduction pro-

ducts. In only one of the solutions, Asparagin, were satisfactory results obtained. There was practically no formation of nitrite or ammonia, and upon plating in ordinary gelatine it was found that while the micro-organisms still possessed vitality, there was no vigor of growth. The cultures in Asparagin developed vigorously, and there was a very marked production of ammonia, the controls yielding no reaction for ammonia. A comparison of the results obtained in these strictly mineral solutions with those obtained from solutions containing a small amount of organic matter, leads to the conclusion that the presence of the latter is imperative in order to secure abundant denitrification. What would be the effect of large amounts of organic matter is still an unsettled question.

5. The Effect Upon Denitrification of an Abundant Supply of Air.

In a study of this question, Deherain in 1897, upon growing micro-organisms from straw and the solid excrement of animals, found that the reduction was much more rapid in closed than in open flasks, although he does not state whether the conditions were strictly anäerobic. Maassen states, that while denitrification is not inhibited by anäerobic conditions, it proceeds best in a limited supply of air. Pfeiffer in 1897, found that in a culture of B. denitrificans the admitting of pure air did not lessen the amount of denitrification. In 1898, Ampola and Ulpiana isolated from soil a micro-organism which grew well both in the presence and absence of air.

In our work, one purpose was to so construct a piece of apparatus that air might be freely drawn through the culture, and yet that the danger of contaminations might be eliminated. Five seventy-five c. cm. Erlenmeyer flasks were tightly fitted with two-hole rubber stoppers and connected with U tubes, one arm of which extended to the bottom of the flasks. Two each of the end flasks contained normal-fifth sulphuric acid, the middle one holding the culture solution. Thus when air was drawn through the apparatus, the sulphuric acid in the first two flasks would absorb any ammonia from the air passing through, as well as any micro-organisms which might be drawn in with the current. The other two acid flasks were to catch any ammonia that might be given off from the culture drawn over upon äeration.

Furthermore, one series each of cultures sealed, and simply plugged with cotton wool were used, uninoculated controls being used in each case; also cultures and controls were placed in an atmosphere entirely devoid of oxygen. The culture solution was prepared similarly to the previous ones of mineral salts and containing a small amount of peptone.

After eleven days growth determinations were made of nitrites and free ammonia in the cultures and controls. The acid flasks of the äeration apparatus were titrated against normal-fifth sodium hydroxide, but showed no indication of absorption of ammonia.

TABLE V.

Nitrites expressed in grams per litre N_2O_3.

Ammonia expressed in grams per litre NH_3.

	N_2O_3	NH_3
Cultures in Absence of Oxygen:		
B. subtilis	None	None
B. megaterium	Trace	Trace
B. mycoides	Trace	.0080
Uninoculated Control	None	None
Cultures Sealed:		
B. subtilis	.0330	.0064
B. megaterium	.0440	.0080
B. mycoides	None	.0240
Uninoculated Control	None	None
Cultures Unsealed:		
B. subtilis	.0440	.0128
B. megaterium	.0495	.0244
B. mycoides	.0551	.0160
Uninoculated Control	None	None
Cultures thoroughly aërated:		
B. subtilis	.0826	.0192
B. megaterium	.1101	.0160
B. mycoides	.0551	.0240
Uninoculated Control	None	Trace

A litre sterile culture solution contains .1264 grams N_2O_3.
A litre sterile culture solution contains .028 grams NH_3.

The results show that the reduction depends almost entirely upon the presence of at least a small amount of oxygen, and that, except in the case of B. mycoides, a greater supply of air induces a greater amount of reduction.

CONCLUSIONS.

1. The three micro-organisms under investigation have the power of acting upon nitrates to reduce them to simpler substances, nitrites, free ammonia, and probably free nitrogen.
2. The nitrites present in a culture solution having nitrate for its basis result entirely from the nitrate.
3. A portion of the ammonia usually found in cultures in nitrate solutions containing organic matter, results from the decomposition of this latter material.
4. For a vigorous development and activity of these micro-organisms, the presence of at least a trace of organic matter is essential.
5. Not all bacteria having the power of acting upon nitrates are also capable of exerting a reducing action upon nitrites.
6. The bacteria studied can not reduce ammonium sulphate; furthermore, the ammonium sulphate checks the production of free ammonia from the peptone in the solution.
7. These micro-organisms act more vigorously in the presence of an abundant supply of oxygen.

THE QUESTION OF WATER-ABSORPTION BY FOLIAGE LEAVES.

J. B. DANDENO, AGRICULTURAL COLLEGE.

As early as 1679 Marriotte gives an account of some investigations and concludes that water may be readily absorbed by leaves. Then Hales, 1725, Bonnet, 1754, Senebier, 1800, Dutrochet, 1837, and a few others publish results similar to those of Marriotte. Views opposed to these were published by Treviranus, 1835, Duchartre, 1861; and especially by many of the more recent text-books on Plant Physiology, such as Pfeffer, Detmer and Vines. Special papers by Garreau, 1849, Cailletet, 1872, Boehm, 1877, Mer, 1878, Boussingault, 1878, and Henslow, 1880, assert in substance as did Marriotte and Hales. The views as expressed by text-books are in general opposed to that of water absorption.

The experiments to inquire into the truth of the matter were in brief as follows:

1. Semi-wilted leaves were weighed, then immersed in water for short periods (from one to twenty-fours hours) then the weight and the visible turgidity taken into account.
2. Repetition of Hale's experiment.
3. Using a manometer where water is applied to one side of a leaf at a time.

These factors were also taken into consideration:

1. Distilled water applied to the surfaces of leaves for a short time usually becomes alkaline and extracts a saline matter from the leaf.
2. The anatomic structures of the leaf.
3. The positive proof that dilute solutions are absorbed by leaves.

SUMMARY OF THE MORE IMPORTANT FACTS.

1. Leaves may absorb water through the surface whether stomata be present or not.
2. In connection with this there generally occurs a loss of saline substance, consequently rain water may aid in relieving the leaves of surplus salts, and consequently may help in excretion.
3. In the drenching of lettuce leaves, it is quite probable that the change in flavor may be due to the loss of substance extracted by the water.
4. The strongest experimental evidence in support of absorption develop from the fact (a) that solutions are readily absorbed, (b) that water extracts substances, (c) that an immersed leaf or branch may contribute plainly toward the turgidity of a neighboring branch or leaf.

PREPARATION FOR DISSECTING PANS.

S. O. MAST.

In view of the fact that such preparations for dissecting pans as are on the market at present, are either expensive or not very serviceable, or both, it was thought worth while to attempt to work up some mixture that would be more serviceable and less expensive.

An ideal preparation for dissecting pans, it seems to me, should be of such a nature that it will hold the pins. It should be soft enough so as not to crack when bent, adhesive enough to stick to the pans, black enough to form a sharp contrast with delicate tissues, and insoluble in solutions (water, seventy per cent. alcohol, and formal) commonly used in dissection.

After considerable experimenting, two preparations were obtained, neither of which prove to be ideal. The formulæ of these two preparations (A and B) are as follows:

PREPARATION A.

25 grams of linseed oil.
50 grams of coal tar.
200 grams of brown resin.
50 grams of hard paraffin.

PREPARATION B.

50 grams of coal tar.
100 grams of brown resin.
250 grams of hard paraffin.

The ingredients of preparation (A) mix most readily if all but the paraffin is first melted and thoroughly mixed, and then the paraffin added and melted and thoroughly stirred. This preparation may be made harder by continuous heating or by decreasing the amount of linseed oil, and softer by increasing the proportion of linseed oil.

As in preparation (A) so in preparation (B), a more thorough mixture is obtained if the coal tar and resin are first well mixed and then the paraffin added, than if all the ingredients are at once melted together. This preparation requires more heating and stirring than preparation (A) in order to cause the ingredients to mix; and at best there will be only a partial mixture. Coal tar and resin being heavier than paraffin tend to collect at the bottom so that in this preparation, it was found best to weigh out the desired amount of substances used, in proper proportion for each pan separately, and melt and mix them in each pan.

As above stated, neither of these preparations is ideal; both lack some essential characteristics. Preparation (A) while insoluble in water and formal is slightly soluble in sixty per cent. alcohol, and quite readily

soluble in strong solutions and consequently is not satisfactory for dissection in solutions of alcohol stronger than about fifty per cent.

Preparation (B) is practically insoluble in ninety-six per cent. alcohol as well as in formal and water, and is consequently satisfactory for dissection in these solutions; but this preparation does not adhere to the pans as tanaciously as preparation (A), and it might also be improved by being made slightly darker in color.

COST.

Coal tar and resin are usually sold by dealers in plumbing material, the former at twenty-five cents per gallon, and the latter at five cents per pound. Linseed oil is handled by dealers in paint. It is retailed at from forty cents to eighty cents per gallon. Paraffin may be obtained from druggists or dealers in laboratory supplies at about twenty cents per pound.

According to the above prices the approximate cost of the preparations would be as follows:

PREPARATION A.

1	pound linseed oil	$0 08
2	pounds coal tar	08
8	pounds resin	40
2	pounds paraffin	40
Total 13	pounds	$0 96

Cost per pound $0 07 5-7.

PREPARATION B.

2	pounds coal tar	$0 08
4	pounds resin	20
10	pounds paraffin	2 00
Total 16	pounds	$2 28

Cost per pound $0 14¼.

The amount of either of the preparations required to cover the bottom of a dissecting pan 5x8 inches, about five-eights inch deep, weighs approximately one-half pound, making the cost of preparation (A) per pan about four cents, and of preparation (B) about seven cents.

THE LIMITS OF DIFFERENCE IN SPECIFIC AND SUBSPECIFIC DISTINCTIONS.

HUBERT LYMAN CLARK.

It was my misfortune last summer to feel called upon to criticise some recent ornithological work in which the process of recognizing subspecies had been carried to the extreme, and my opinions were published in SCIENCE, August 8, 1902, under the heading "So-called Species and Subspecies." In the same journal, September 5, Dr. J. A. Allen, the well known zoologist, criticised my opinions as those of a layman, and emphatically denied two of my main contentions. As nothing is gained by newspaper controversy, I made no reply, but the questions involved are extremely important and after six months further consideration of them, I have decided to set forth what seem to me some of the fundamental rules, which ought to govern work in systematic zoology. First, however, as Dr. Allen has challenged my right to opinions on the subject, it is only fair to say that, although I have never described a new or supposedly new bird, I have had occasion to examine carefully several thousand specimens of echinoderms, and have been under the necessity of naming a number of new species in that group, so that I am not an entire stranger to the numerous perplexities of the systematist, to which Dr. Allen refers. Now I freely admit that from the systematist's point of view, birds are more perplexing than echinoderms, and that Dr. Allen, both because of his naturally judicious temperament and by his many years of experience amid exceptional opportunities, is far better qualified to discuss this subject than am I. Yet I do feel, that whether the animal be a bird, a fish, a worm or an infusorian, the essential principles of systematic zoology ought to be the same in all cases, and that any zoologist who has wrestled honestly with the knotty problem of specific distinctions is entitled to opinions on the subject. I therefore venture to state some of these essential principles as they appear to me.

1. Characters which are not sufficiently conspicuous, so that they can be stated in language or figures of some sort, ought not to be made the basis of a new name.

This principle appears so axiomatic that an apology would be made for stating it here, if it had not been seriously questioned by Dr. Allen. He says: "In ornithology, and especially in mammalogy, perfectly 'good species' are often so similar in size and color that even the expert cannot satisfactorily identify them from descriptions, and hence, almost from time immemorial, direct comparison with authentic material has been necessary in order to settle such difficult cases. As all experts in this line of study well know, forms that may be indistinguishable by descriptions are, when brought together, and especially when series are compared, so noticeably different that there is no trouble in distinguishing them at a glance." Now I must confess that after giving these words careful

thought I am unable to believe that the validity of my contention is affected. I am utterly unable to conceive of two objects, which I could "distinguish at a glance," the differences between which would be so intangible that I could not state them "in language or figures of some sort." As to the comparison of specimens with types or other authentic specimens, "from time immemorial," surely it is well known that the necessity for this is due to imperfect, inaccurate and erroneous descriptions, and not to the fact that "perfectly 'good' species" cannot be distinguished without comparison. If a character, whether in color, size, form, texture, odor, notes, habit or anything else, cannot be detected by sight, touch, smell, taste or hearing to such a degree as to admit its translation into intelligible language or figures, it surely is not fit to be made the basis of a new name. Of course I do not contend that the "language or figures" must be intelligible to the "layman," for that unfortunately is not at present feasible and probably never will be.

2. Differences in dimensions, of less than five per cent., ought not to be made the basis of a new name.

This principle is certainly not radical, yet it would shut out a large number of recently described subspecies of birds, and perhaps other animals also. The reason for this rule is that individual variation in a species is so much larger than was formerly supposed, no constant difference can be maintained between two forms which differ from each other by less than five per cent. in size. I believe ten per cent. would be a safe rule, but if five per cent. could be agreed on many ridiculous new names would never see the light of day. In Dr. Allen's famous paper "On the Mammals and Winter Birds of East Florida" (Cambridge, 1871), he says: "The facts of the case show that a variation of from fifteen to twenty per cent. in general size, and an equal degree of variation in the relative size of different parts, may be ordinarily expected among specimens of the same species and sex taken at the same locality, while in some cases the variation is even greater than this." Such being the case five per cent. is not a high standard to suggest.

3. Characters which cannot be recognized without knowledge of the geographical origin of the specimen ought not to be made the basis of a new name.

This is a very essential principle if we agree that an important end of systematic zoology is correct knowledge of the geographical distribution of animals. It seems to me axiomatic that characters which cannot be recognized regardless of the locality where the specimens are collected are worthless, yet Dr. Allen holds to the contrary, and regards my support of this principle as evidence of my writing without possessing the necessary familiarity with the facts. The horned lark from Mexico named *Otocoris alpestris chrysolaema* by Oberholser differs from the same author's subspecies *actia* so slightly that he himself admits they are indistinguishable, unless the locality where collected is known. I am unable to see what possible gain there is in giving a name to such a form; while christening it may easily lead to serious errors in determining the geographical distribution of the real subspecies of horned larks. And in all

other groups of animals, the confusion of special geographical position with essential morphological character leads, and always will lead, to most erroneous conclusions concerning the distribution and history of species. A well known American mammalogist is said to hold the view that any mammal resident on an island must necessarily be a different sub-species from the form on the neighboring mainland, because of its isolation. If such views are current among systematists, (which I greatly doubt), it is not strange that morphologists, physiologists and embryologists have long held systematic zoology in contempt, and even now regard with suspicion our claims to a place among the real devotees of science.

4. Characters which will not distinguish corresponding ages or sexes of two forms ought not to be made the basis of a new name.

This seems so self-evident, I hesitate to state it but as it may prove the one on which we can all agree I mention it, although it is no more obvious to me than principles one and three. Of course this does not mean that the characters must be present in both sexes at all ages. On the contrary, the characters may be present only in one sex or at a particular time of life, but they must distinguish from the corresponding sex or age.

5. Characters which are notoriously variable in a given group ought not, within that group, to be made the basis of a new name.

As an example of what is meant by this principle, the common starfishes (*Asterias forbesi* and *vulgaris*) of the New England coast may be cited. Their color is so remarkably variable that it would be folly to form subspecies based upon the color alone.

6. Characters which may be fairly interpreted either as individual peculiarities or as dichromatic diversity, ought not to be made the basis of a new name.

If this principle were honestly followed many new species and subspecies would be cancelled, and it would lead to much greater caution in basing new names upon single individuals.

The above six principles are suggested, not with any idea that they will meet with universal approval, but in the hope that they may precipitate a discussion which will lead to definite results. At some not far-distant day let us trust, the charge of basing new names upon "distinctions without a difference" will be one that cannot be brought legitimately against American zoologists.

THE SOCIAL PHASE OF THE RURAL PROBLEM.

BY KENYON L. BUTTERFIELD.

It is needless to dwell upon the fact that a subject of such magnitude as the advancement of the agriculture of the United States has many phases, each one of which is important and even vital. We have, for instance, the purely business aspect of agriculture, both on the side of farm management, which is another term for the art of agriculture, and on the side of marketing, which may stand as a general term for the activities of the farmer on the outside of his farm. To many men this seems to be the keynote of a successful agriculture: Give us men on our farms of keener business instincts and you will insure rural prosperity. This is the attitude of many intelligent farmers and of those agricultural editors who themselves possess the business instinct.

There is also the economic aspect of the problem, which is the business aspect in its larger phases. The development of the markets for agricultural products both at home and abroad, the competition of other countries, the relation of our great transporting systems of the industry of agriculture,—these things are all of prime interest to the man who has a bent for political economy, and to those students of the problem who have wide horizons.

We have also the political aspect of the problem, which comprises not only the attitude of the farmers on public questions, but also the relation of legislation, actual and proposed, to the industry of agriculture. These matters are of moment to statesmen and politicians both among farmers and people generally. Many important and significant questions come up under this phase of the problem; questions that we have no right to dismiss by ironical use of the word "politics." I for one believe that the political aspect of the rural problem should engage serious attention.

We have also the scientific phase of the rural problem, and this I take it is the aspect that is of especial interest to this Association. This includes the development of the more purely scientific phases of agricultural investigation as well as of the more concrete problems of applied science.

All of these you will admit at once are important phases of the rural problem. It is difficult to say which phase is the most important one. I doubt if any of us can look at the agricultural question in a broad way without concluding that the problem can be solved only by satisfactory progress along all of these lines. While different men may feel that the business phase, or the economic phase, or the political phase, or the scientific phase of the farm problem is the mose interesting and important, I think all will admit that it cannot stand alone, and that it does not necessarily follow that rich progress along one of these lines alone insures equal progress along the other lines.

But there is another phase of the farm problem that has not been sug-

gested in the above classification. I would call it the social phase of the rural problem. This is perhaps not so much a branch of the agricultural question as it is a discussion of the entire problem from the social point of view. It is that point of view which considers the *farmer* primarily, rather than his business or industry. And it considers him not merely as an individual farmer, but in his various relations to his fellow farmers and to society as a whole. The social phase of the rural problem has to do, of course, with special aspects of the question, such as education, morals, social conditions, certain forms of co-operation. These in themselves are phases of the rural problem, but they may for convenience all be grouped under the term "social." From the social point of view we not only study those things that have to do with the social relations of the farmer, but we have to take into consideration also the business, the economic, the political, and the scientific phases of the question. For this reason I suggest again that the social phase of the rural problem is not so much a branch or division of the subject as it is a discussion of the entire rural problem from a certain standpoint. I emphasize this idea, because I wish to avoid if possible the imputation that I am merely laying stress upon a certain section or compartment of the structure. I wish to consider the whole question, but to lay stress especially upon the method of approaching it.

You will see that from this standpoint it is easy to argue that the social aspect of the rural problem is an absolutely fundamental consideration; and we may suggest two reasons why it is so. In the first place social progress is an end in itself. We all admit that the ultimate thing is not larger crops or greater returns per acre, but better men and women, finer conditions of life, and in general, an elevation of the farmers themselves. This, I think, needs no argument, but is not so important a reason as the next one I shall suggest, which is that social agencies are the prime means of advancement in agriculture. That is to say, we may all agree that better business talent, greater economic success, wider political influence, and an application of science to the art of farming are all factors in rural progress; but the point I am trying to make is that looked at in the larger way, those things that we would call social agencies or social forces are the things that are practically indispensable in order that we may have better business farmers and wider industrial success and greater political influence and an intelligent application of science to farming. Take it on the purely business side, for instance, the successful marketing of farm crops is first of all something that comes through the man who has keen business instinct and a knowledge of business practice; who is alert and farsighted; but it is perfectly possible to cultivate this trait in men by education, to have better means for communication between farm and market, to increase the knowledge of the world's markets, to secure laws that prevent transportation companies from unjust charges, to make an application of science that preserves the product in condition for a long journey. We can name a score of ways by which this business talent, which is first of all a personal possession of the individual farmer, can be materially aided and even cultivated, or on the other hand, can be discouraged and even stifled, by the possession or the lack of such social agencies as the Department of Agriculture, the agricultural press, agricultural educational institutions, the farm telephone, rural mail delivery. It would not seem as if this point needed further argument.

But simple as the proposition is, it is so simple that it is often overlooked, and for this reason the social phase of the rural problem is very much a neglected factor. Each of us is so prone to see the entire problem through the spectacles of his immediate work that he fails usually to appreciate and to make use of all those other agencies that are of importance.

All of the above discussion really leads to a consideration of a subject which for want of a better term we may call "Rural Sociology." And having endeavored to show the importance of the social aspect of the rural question, I wish to make this paper of some practical value by making a plea in as brief a manner as possible for the study of rural sociology. The meaning and scope of rural sociology can best be indicated by reviewing some of those themes that would naturally be taken up under such a title. In studying the social aspect of the rural question we ought first of all to find out the real condition of affairs—to study the rural status. In doing this we must study the condition of the industry of agriculture, its nature, its present status, its relation to other industries, the relation of science to agriculture, and so on. We must study the rural population and endeavor to explain the movements of that population. We should study rural social conditions as they relate to morals, crime, intemperance, illiteracy, charity, etc., etc. We need to make a study of the traits that are developed by farm life, and the influence of those traits in retarding or assisting rural progress. In general, we need to find out all we can about the conditions of farmers today, how they live, how they think, the influences that surround them. We must get a good idea of the whole rural question. When this is done we need to study more especially those social factors that seem to be making for rural progress—the development of means of communication in rural districts, as by roads, telephones, rural mail delivery, electric lines; the need for farmers' organizations, their value, thier history, and their achievements; the study of the rural school question from the standpoint of the opportunity to be given rural children to enter any occupation in life; the study of all the many means of agricultural education, including the work that can be done with the younger people in the primary and secondary schools; all the work of our agricultural colleges and experiment stations, farmers' institutes and reading courses; nor must we neglect the country church, an institution that we can hardly regard otherwise than as absolutely necessary to satisfactory rural life, and yet one which is apparently not meeting the demands made upon it. We can also study how far it is possible to secure co-operation among all these agencies. These subjects and themes like them are the legitimate field of rural sociology. You will see that it is not so much a new thing as a co-ordination of old things. It is looking at the farm problem from a little different point of view.

In pleading for the study of rural sociology I want to suggest a few advantages that it seems to me it possesses as a subject of study. In the first place, it is a subject of great interest to farmers. I think it is increasingly clear that our more intelligent farmers view the problem that faces them very much from the standpoint that I have been indicating. They don't call it rural sociology perhaps, but if you will observe the progress of Granges, and institutes, and farmers' congresses, you will note the increasing interest in those very aspects of the ques-

tion which I have been emphasizing. This it seems to me is significant; it shows the current of agricultural thought and it invites co-operation on the part of agricultural educators. In the second place, through this problem we soon reach the larger questions in agriculture. We are viewing the problem in its entirety. The subject is therefore a broadening one, and I think any specialist or any man interested in the practical phases of the question is a more useful man if he really sees the relation of his particular field to the problem as a whole. In the third place, it gives new meaning to our agricultural life, placing it on a much higher plane from the intellectual standpoint and thus bringing the interest of other people to the aid of the farmer. And finally, it encourages co-operation for rural progress, making it clear that the rural question is many-sided, that there is no one panacea for the difficulties, that advancement must take place all along the line.

The last question I wish to consider is, how can rural sociology be made useful? It certainly should be taught in our agricultural colleges in some form or other; no graduate of an agricultural college ought to be ignorant of this phase of the question no matter what his life work is to be. It will, I think, yield itself splendidly to college extension work in agriculture. I think country teachers and educators should be made familiar with the social aspect of the farm problem; that preachers—and especially the country clergymen—should have an appreciation of the question. There is no reason why it may not be given as a course in universities in order that intelligent people generally may have some comprehension of the importance of the agricultural question.

I have made my paper merely suggestive because I wished to bring the matter to your attention. I hope I have been successful in making very clear just what I mean by the social phase of the rural problem, and that I have been able to impress upon you not alone its importance but also the practical means for inducing farther study of the questions involved.

FORESTRY FROM AN ECONOMIC STANDPOINT.

BY E. E. BOGUE, MICHIGAN AGRICULTURAL COLLEGE.

In these days of get-rich-quick schemes forestry cannot be said to stand much of a show in the race for riches. To be sure, land may be secured by purchase or otherwise, that already supports a good stand of available timber that in a few months or even weeks can be converted into ready cash. This compares favorably with other schemes for obtaining quick returns. But this is not forestry. It may be called one branch of the subject carried on in a rude manner and may be compared to the man who cuts down his cherry trees in order the more easily to gather the fruit. It sometimes happens that it is good policy to take off an undesirable portion at time of fruiting and so it is desirable and proper to remove a portion of the forest crop in order to save the part removed and prevent injury to what is left. A common way of timber disposal is to sell everything a man will buy on the stump regardless of species. A somewhat less disastrous method is to sell only certain species as, for instance, all the oak or ash or elm or pine or any particular species. This removes not only that which is ripe and ready for harvest but much that is in its prime and capable of earning more money for its owner than at any other period of its life. In some cases there is a large number of small seedlings an inch or less in diameter that are fatally injured. Such work frequently destroys an even stand. The step from this to the scientific method which if followed will continue to yield a definite harvest at stated periods for an indefinite time is not so great but that any one who owns a piece of woodland can take it. Forestry enthusiasm should not lead any one to the presumption that clean cutting should never be practiced, for sometimes this is the wisest thing to do. Last summer I visited a tract of Norway pine in Crawford county, that was being cut and from the felled trees it was evident that they were just about keeping alive. The stand was crowded, about 240 trees per acre, and cut about 7,000 feet B. M. They were cut up into convenient lengths and forty to eighty loaded onto a flat car. The diameter of the ends of these pieces ranged from three to seventeen inches and the average of fifty measurements was 10.1 inches. The scale per car was about 2,800 feet B. M. There was no undergrowth to speak of and it was evident that harvest time for that timber had both theoretically and practically come. Only a few minutes' walk from these trees was a tract of about twenty acres that had been cleared some years before and which now supported a fine stand of growing Norway pines about waist high. On a single square rod were counted no less than 95 young trees.

The man who has to deal with trees needs to use good common sense just as well as, and sometimes more than, anybody else. In the case cited this company has control of large areas and has not, I understand, the least intention of undertaking to make this land into farms. They know well enough that such a venture would prove a failure, because the land is not at all adapted to either special or general farming

but if left to its own sweet will and not disturbed by fire and browsing animals will reproduce a crop of trees. How long will it take to do this? Sixty, eighty or a hundred years. Suppose the present stand is worth six dollars per M. on stump, then an acre is worth $42. Now this $42, at simple interest will, in 100 years double itself six times or at the end of the period will amount to $2,688. If protected from fire and stock this acre will at the end of the time have another crop that will in all probability with the normal increase in price of lumber be worth at least three times the present crop or $126. The calculation need not be carried farther to prove that forestry of and in itself does pay on land that is not at all or poorly adapted for growing farm crops.

The business of forestry for lumber does not lend itself readily to the pursuit of the private individual of small means but, to meet the best success, must be carried on by companies or by men of large means who are accustomed to looking far into the future and can afford investment at low rates for long periods.

One may grow posts and poles in as short a period as twelve years and although the demand for these things has never been and probably never will be so great as for lumber, yet the man who grows a few acres of trees for home use will soon find that he has enough and to spare, for if he succeeds in raising only 1,600 posts per acre at 320 per mile this one acre would yield enough posts for five miles of fence.

It remains to be proven that forests actually cause an increase of precipitation, but there is no doubt that they do have an important influence on what does fall. We cannot to any appreciable degree modify cosmic climate. We can modify local climate only within very narrow limits, but one thing we can do and that is to take care of the climate that nature gives. In some points forest crops are comparable to agricultural crops, but in many ways they are not. A forest in its proper sense has a wider influence than the boundaries of any one farm or township and often even counties. The ultimate influence of a forest may be felt hundreds and even a few thousand miles away. Just at this moment the lack of forests about the head waters of the Mississippi is, if doing no greater damage, driving hundreds of people from their homes that are scattered over the country in Arkansas, Louisiana and Mississippi. The sudden and excessive swelling of our rivers which carry away bridges, buildings, farm and manufacturing equipment, livestock, sometimes human beings and vast quantities of the richest and best soil, these are the things that should and will in time support "Forestry from an Economic Standpoint."

THE SCOPE OF THE AGRICULTURAL SECTION OF THE STATE ACADEMY OF SCIENCE.

BY PROF. W. J. BEAL, AGRICULTURAL COLLEGE.

The existence of a section of Agriculture in the Academy of Science of any State in this country is unique. I think Michigan is the only State where such a section can be found.

A few years ago when a committee of the Academy met the committee of the Legislature in an effort to secure the publication of our proceedings, the first question asked was: "Of what use will it be to the citizens of the State?" Prominent among the answers devised by the members of your committee were the naming of a number of investigations which have a direct bearing on agriculture, such as the vitality and distribution of weeds into the State, the study of the changes in the condition of trees after three-fourths or more of them had been removed, the thorough investigation of the habits of birds and fishes, including their food.

For a long time, sheep in some parts of England were subject to a disease of the liver known as Liver-Fluke. Many theories were advanced to explain the cause. A. P. Thomas, a professor at Oxford, solved the mystery by demonstrating that the parasite of a small snail which fed on the grass and when eaten found its way to the liver of the sheep. The remedy was simple: Keep the sheep off the low land pastures. The above example was instanced to the Legislative committee as a striking illustration of the need of well-trained scientific men. No one can foresee all of the emergencies which such a man may be called on to investigate.

I offer no apology for the formation of an agricultural section of our State Academy, but for the benefit of some who have not canvassed the subject, I mention a number of topics that may be considered appropriate to occupy the time of the members:

Most of the recent investigations included under the term soil physics; irrigation and the management of rain and snow for the growing crops; meteorology; much of agricultural chemistry, the composition and use of fertilizers.

Under the general head of Plant Industry, we have the following and others:

Methods of testing agricultural seeds for purity and vitality; absorption of water by grain; the nature and use of tubercles on the roots of legumes. As long ago as 1896, a firm in Germany had for sale to farmers seventeen kinds of pure cultures for soil infection to help in growing as many different species of legumes. Field experiments on plats, plants grown in pots or boxes for testing fertilizers and comparing varieties may here be mentioned; experiments with new grasses and other forage plants; all sorts of farm crops; farming under glass; the formation of a good lawn; the flora as affected by the soil; the flora as indicative of the soil; agricultural or economic botany; much of what we term

forestry; the introduction and distribution of weeds; plant diseases and their preventives; improving plants by selection, cultivation, crossing and hybridizing.

Animals.—Concerning these are suitable topics for us to consider: Fish culture; bee-keeping; insects injurious to cultivated plants and remedies; the habits of birds with reference to benefiting or injuring farm crops; animal plagues in great variety, veterinary science; dairy husbandry in its broad sense; experiments in feeding cattle, sheep, pigs, and poultry, for specific purposes; breeding and improving any kind of domestic animal.

Concerning the Human element in Agriculture, the following may be enumerated: The education of the young farmer in school and college; the aims, methods and results; the improvement of the citizen in grange, club and institute; the management of county and State affairs and making exhibits; the relations of botany, geology, zoology to agriculture; the connection and relation of science and art in agriculture; the progress or methods of any portion of farm industry; the sugar supply; the meat supply; transportation of farm produce; how to reduce the cost of production and marketing of farm products; and how to enlarge foreign markets for the same; the history of agriculture or any portion of it; political economy and sociology for the farmer as a citizen. This enumeration will suggest other allied topics.

PRESENT METHODS OF TEACHING SOILS.

PROF. J. A. JEFFERY, AGRICULTURAL COLLEGE.

The present methods of soil study are somewhat evolutionary. There are few institutions that are offering more than a very simple course in soil work. In most of our colleges the work is given by men whose training has been along other lines, but who occupy the position of agriculturist, who feel the importance of a larger knowledge of the nature and principles of soils, and who with the time and facilities at hand are doing what they can in this direction.

The University of Wisconsin was the pioneer in the development of a strictly soil course. Ohio followed with a less extensive course and Illinois is building up such a course. M. A. C. is doing a similar work and South Dakota is doing a very creditable line of work, while the letters of inquiry that come to us from east and west for information as to methods, show how rapidly the interest is growing—Connecticut, Iowa and Oregon within the past few months. Wisconsin is doubtless best equipped for the work. Illinois, Ohio and Indiana have splendid facilities in the way of quarters and are rapidly building up their other equipment. Iowa has a magnificent building in sight and North Dakota is transforming a part of its boys' dormitory into a soils laboratory.

Where room and equipment are provided, a serious difficulty is encountered in securing trained men to take up the work of instruction and direction. In some cases men are put in charge who have to build up their departments and themselves at the same time. In other cases funds for the development of such a course come slowly.

Scarcely any two institutions offer like courses or follow the same methods of instruction, and yet, all pattern to a greater or less extent after the methods developed by King of Wisconsin and in addition give some attention to methods of soil investigation practiced at Washington and by Hilgard of California.

The time of taking up the work in soils and the time given to the work, are not the same in all institutions. At Wisconsin no work in agriculture is given prior to the junior year. At that time if the student elects soils as his major, that work is followed by him during the junior and senior years. If soils is made a minor, the time devoted to soils is much less depending upon the other elections made. At Ohio one term is given in the junior year, while agronomy, which includes one term of soils, may be elected for the senior year. At Illinois soils is a required study during the first semester of the junior year, while electives are offered during the senior year. It will be observed that in the three cases just named, no work in soils is done prior to the junior year and is thus taken after two years of university training.

It is the plan at M. A. C. to give some work relating to agriculture in every term of the freshmen and sophomore years, with the privilege of electing agricultural work during a part at least of the junior and senior years. The object of this arrangement is that many of the students

coming to us remain only through one or two years. Such students going back to the farm take with them knowledge relative to agriculture that shall increase their capacity as producers.

The first work in soils is given during the last four weeks of the winter term. This work consists of lectures upon the history and distribution of the principal types of soil. In this work it is sought by simple talks to show that all arable soils are derived largely from rocks, to show what agencies—heat, moisture, air, plant and animal life, etc., are operative in bringing about these changes, and that the value of any soil will depend very largely upon the nature of the rock from which it is formed.

A soil may occupy the position—practically—in which it was formed. Such soils are found in the limestone area including a part of southwestern Wisconsin, and in the sandstone area lying to the north of it. Such soils are called residuary soils—soils of immediate origin. The location of the principal areas of this type of soil is indicated.

The formation of the drift, or till soils, volcanic soils, alluvial soils, wind blown soils, etc., are taken up and their characteristics, qualities, and possibilities discussed. As in the former case the location of these soils is indicated. The peculiarities of the soils of the arid regions and of prairie soils, and some at least of the causes thereof, are discussed.

As far as possible samples of the several soils are shown to the class and the talks are illustrated by lantern slides. To this end we are gathering samples of soils from different sections of the United States, and we have one sample from Burmah, India. We are also adding to our collection of lantern slides. In all this we show that many of the agencies active in building up soils may become active, under proper conditions, in wasting the soil. We show how nature, left to herself, holds and improves her soils, and so far as possible, we show where we may imitate nature both in conserving soils and in obtaining the largest returns from them.

We explain how valuable soils are injured or destroyed by the carelessness or ignorance, or both, of the husbandman, giving some estimates of the extent to which lands have been injured or destroyed and calling attention to some of the cases in which large areas have been abandoned because of their impoverishment. We call attention, too, to the manner in which soils affect the type of manhood, apparently, and the history of nations as well.

We find that almost without exception, these simple talks arouse a good deal of interest in the student. The soil becomes to him a thing of life, so to speak, and he seems to acquire a new respect for it.

This work is given in the form of lectures because there is no satisfactory text-book on the subject to be had. Students are required to make careful notes.

During the spring term of the freshmen year we give attention to soils from the agricultural standpoint.

We discuss the chemical composition of soils and estimate, from analyses given, the amounts of the several plant foods in the first foot and in the first four feet of soil, and then from the computed quantities of material removed annually by crops, estimate the possibilities in our soil of crop growing. The fact of the wearing out of our soils and their unproductiveness are compared with our theories, and explanation sought for the apparent conflict.

Attention is given to the biology of the soil which concerns bacteria and mold life found therein and the functions of these in transforming the store of nitrogen in the soil and probably also the mineral foods into soluble form for the use of the higher plants.

Soil moisture, soil air, and soil temperature are taken up in order and studied under the general heads:

(1.) Importance to crops and the changes above referred to.
(2.) The ideal conditions, and
(3.) The means by which the farmer may modify or control them.

The third head naturally leads to the study of farm implements and the art of their construction and use and also to the study of the theory and practice of farm drainage.

Fortunately we now have a few very good texts upon soils as we take them up during this term which we are able to supplement with laboratory and field practice.

A portion of the sophomore fall term is given to the study in the laboratory, of air movements and water movements in the soil, to the determination of the moisture content of soils and to the mechanical separation of a sample of soil into its sand, silt, clay, and organic constituents.

The work thus far outlined is required of all agricultural students. Any further work he may take is made up of what it may appear paradoxical to call required electives. In the winter term of the junior year, the student elects between horticulture and agriculture. Should he elect agriculture, he plans to specialize in soils and crops or live stock or dairying. If his election be soils or soils and crops, then during the spring term of the junior year, he devotes ten hours per week to carrying out some practical experiment planned during the winter term, along some line of soil or crop work, as for example, to determine the amount of moisture taken from soils by a crop of weeds or the effect of manures upon soil temperature.

Eleven weeks of the fall term of the senior year are devoted to laboratory studies of soils. Four to six samples of soils are given to the student of which he is to determine the specific gravity, apparent specific gravity, least pore space, waterholding power—capillary and hygroscopic, and the effective size of soil grain with the theory of the methods, to classify and compare the several values and discover, if possible, any existing relations.

The electrical method and its theory for determining the soluble salts in soils is studied and the apparatus operated.

During the winter term of twelve weeks, each student carries on some line of investigation, giving ten hours per week to the work. This work is written up in the form of a thesis.

In the spring term soil thermometry, evaporimitry, and the natural pore space of soil is studied and if any time is left some problems in soil mathematics, such as the estimation of the total surface of unit volume of soil and some of the theoretical values and actual values compared.

While the work of the senior year possesses no small value for the young man returning to the farm, it is planned especially with a view to better equipping him to take up the work of instruction or investigation. The demand for young men for these lines of work at the present time is very great.

ECONOMICS OF HORTICULTURE.

PROF. C. P. HEDRICK, AGRICULTURAL COLLEGE.

The rapid development of fruit growing is one of the marvels of our American industries. Scarcely known a half century ago as an industry it has risen to a commanding position in the country at large, and in some States it is the dominant feature of agriculture. The figures of the fruit industry for the last decade are a grand sight. They show that the home consumption of fruit has increased enormously. Exports of fruit have nearly doubled yearly. Imports, except of the banana, have almost ceased. We have home grown oranges, lemons, grape fruits, raisins, prunes, almonds, figs, dates and nuts where formerly all came from across the sea. The carload is the unit in trade now—formerly it was the wagon-load. Instead of peddling the product out in the neighboring town, as was done a generation ago, we have created markets in distant cities, in non-fruit growing States, and even in other continents, and there is now seemingly no limit to market development.

To what do we owe this wonderful growth? Is it due to changes in soil or climate? No! These are the same as they were fifty years ago. Is it due to improved methods of growing and caring for plants? There has been a decided improvement in plant cultivation in recent years and tillage, pruning, spraying and the advent of many labor-saving implements account for much of our progress, but improved cultivation is not, valuable as it is, the greatest factor. Is it due to the introduction of new types of fruit as the Russian apples, Japanese plums and pears, native plums and grapes, and the fig, the date, the orange, as well as many new varieties of old types? New fruits have certainly had their influence but new types and new varieties, though often ascribed as the chief feature of modern horticulture, are less important than the grand factor to which I now come;—namely, improved economic conditions.

I mean by improved economic conditions, established markets and established routes to markets; greater market demands brought about by more people who eat fruit; a better regulation of supply and demand; the discovery that markets can be created as well as found; and a more common knowledge of the laws of cost and values. We have also much improved the means of distributing the product. This has been brought about by rapid and regular transportation by steam and by electricity on land, and by steam on water; by refrigeration; by shipping through fruit unions; and by aid of the telegraph, the telephone and the rural mail which bring to the agricultural producer the world's market prices from day to day.

Coming now to the subject of my paper, I ask you to consider with me for a brief time a few of the most important of these economic problems, especially in their relation to the present and to the future.

By far the most important economic problem for the fruit grower is the distribution of the product. The great underlying difficulty in distributing all products of the soil is speculation. From the time fruit

leaves the orchard until it reaches the consumer there is no period but that its value may rise or fall to the extent of profit or loss to the owner. Now this risk is shifted for most part by grower and by consumer upon a class of speculators—the commission men. The problem of distribution of product largely resolves itself into that of reducing risks in accordance with the economic law that: "Reduction of risks reduces rates."

How can this be done? Economists are well agreed upon the subject. The risks may be reduced: First, By eliminating middlemen, who create new risks for the sake of speculation, or by reducing their influence to the minimum. This can best be done by co-operative marketing. Second, By better transportation, refrigeration and cold storage facilities.

With reference to the first factor. The history of the progress in the distribution of live stock, grain, wool, cotton and tobacco, in which middlemen have been well nigh eliminated or their charges reduced to a mere trifle, shows what can be done. Distribution of grains, including all the expenses from standing crop to the consumer, costs about ten per cent. of the price paid by the consumer. For fruit and vegetables the cost of distribution from orchard and garden to the consumer, is rather above fifty per cent. of the consumer's price.

It should be said that there are reasons why the cost of distribution is greater for fruits and vegetables than for the above farm staples. They are more perishable; it is more difficult to handle them; and the demand is not so steady for them. But half or more of what a man pays for fruits and vegetables should not go to the distributing agents. The margin between the amount paid by the consumer and the amount received by the producer is too great and fruit growers are making every effort to substantially and permanently reduce it.

As I have said the chief of the ways of doing this is by co-operative marketing for the most part through fruit unions. These are now to be found in all fruit growing centers, but have not attained the success in the East that they have on the Pacific Coast. A comparison of Michigan unions, of which there are several, with those of California, where they have been most successful, making due allowance for the difference in conditions, seems to show that we have in Michigan the following difficulties to overcome: First, The volume of business in most cases is too small. The cost of many items is as great for a small company as for a large one, thereby greatly increasing the cost per individual in the small union. The opposite extreme might, however, be quite detrimental. If an organization attempted to cover too much territory and had a very large membership the varieties and the grades of the product might easily become too varied. Second, It would seem from a comparison of salaries that our unions are not willing to pay for the best possible management. Fruit unions must compete with private enterprises in which are ability, experience and no fear of hard work. Men with these qualifications well developed must have good wages. It costs to organize and to hold the organization. A man must have tact and patience to be a good organizer. The salaries paid in California for the presidency are such that exceptionally able men are secured. For the largest of these unions, The Raisin Growers' Association, the president receives $12,000 per annum. Third, The soliciting feature has not been sufficiently developed in our State. To secure the highest prices the good qualities

of the product must be brought to the attention of buyers by solicitation. Co-operative concerns deal largely with retailers who have no men in the field, thus a soliciting agent is a necessity for any union doing a large business. Fourth, There is a lack of cash capital in the average co-operative company. Many fruit growers must borrow on the coming crop. Associations have to compete with private buyers who supply their agents with ready cash to advance on the crop. Fifth, Fruit unions seldom adjust themselves properly to the regular trade. They quarrel with commission men and seldom are able in times of glutted markets to deal with them. For most part the relations between the unions and the retail dealers are strained, each suspects and watches the other.

These, in brief, are the chief difficulties to be overcome in the co-operative movement,—difficulties not at all insurmountable but ones which are likely to be lasting, inasmuch as they must be overcome by the proverbially conservative producer.

The second problem, and one which is rapidly solving itself, is transportation. In transporting fruit there are now two distinct undertakings. First, To lay the fruit down in the least possible time in a designated consuming centre—transportation proper. Second, To see that the fruit reaches aforesaid center in the best possible condition—or refrigeration. The California fruit-growers succeed in putting their fruit upon the market in better condition than do growers in any other section and under the tremendous disadvantage of distance, and of mountains, deserts, and extremes of heat and cold to be traversed.

Three factors enable California to thus out-rival competitors in transportation. First, Co-operative marketing systems are largely developed in that State and these by combining into Fruit-growers and Shippers Unions, secure valuable concessions from railroads. They are enabled, also, to distribute the output evenly among large and small markets thus avoiding gluts and depressed prices.

Second, They try to ship nothing in the fresh state but the very best, put up in a neat attractive way and in the best condition to stand shipment. California is largely enabled to thus ship a better grade of fruit than competitors because canning, evaporating and by-product establishments, to use the poorer grades, are found wherever fruit is grown.

Third, The improvement of fruit cars to secure ventilation and refrigeration. This is more important to them than to other shippers, yet there is much to be improved in these respects in Eastern shipping. Refrigeration is a technical and a difficult matter. Fruit-growers must force the fruit shipping railroads to take the matter up and give efficient and cheap service in this respect. California has done this.

Leaving the matter of transportation we come to a third problem, cold storage. Cold storage is playing a most important part in the economic development of commercial fruit-growing. It improves prices for both producer and consumer in that it keeps up the price for the producer when the market is overloaded, and in turn keeps the market from rising when the supply from the grower is small. It doubles the selling season for most fruits. Its possibilities are not yet remotely realized. Another decade and many large fruit farms will have cold-storage houses. The construction of a cold-storage plant by a number of growers in one locality is a feasible plan and ought to pay. City cold storage charges are exorbitant for bulky fruits and vegetables which are

to be kept more than a few weeks and frequently force the holder to market his stock at an unfavorable stage of the market. Fruitmen, dairymen, and poultry men could well combine and operate a single establishment.

The cold storage business as sometimes carried on is detrimental to the grower's interests. When storage is used as a last resort to save produce that is "going bad," the goods are not selected and enter in poor condition and will, of course, spoil soon after coming out. Such produce sells poorly. The storage establishments and transportation companies profit temporarily, but the producer loses as do the others in the long run, for shipments are discouraged by depressed prices.

Another economic problem of prime importance is that of the division of the fruit markets. Fruit-growers sell their product in two distinct markets. These are better distinguished as the general and the special markets rather than the wholesale and the retail. The two differ in almost all respects and the differences are such that they must be recognized by the producer. These may be set forth as follows:

The general market handles fruit in large quantities; the special market, in small quantities. In the general market the price is set by the world's product; in the special market there is only local competition and often times this is eliminated as when one secures regular customers. The margin of profit is much less in the general than in the special market. Salesmen either through commission houses or fruit unions are required in the general market; the fruit grower is his own salesman in the special market and is thus directly responsible for his wares. The general market demands a few standard varieties which are commonly known by consumers; in the special market the number of varieties is unlimited and the varieties are gauged by their intrinsic worth —not by reputation. Fruit for the general market must be such as will stand handling and more or less rough treatment; in the private market delicate texture and fine appearance at the expense of shipping qualities are admissible. Packages differ in the two markets. The general market requires standard packages which are always gifts to the consumer; in direct sales any neat, clean package is acceptable or the fruit may be sold direct from the bulk lots. The package need not be a gift. The seasons differ for growers in the two classes. Fruit out of season is not wanted in wholesale markets. The retail market will pay handsomely in most cases for out-of-season products. These, in brief, are the particulars in which the two markets differ most. It is of the greatest importance that the man who grows fruit for sale understands the requirements of the market in which he sells.

One of the considerations which in the past has been a minor one but which now begins to assume large proportions in fruit production is the utilization of wastes. In modern manufacturing industries the saving of the wastes and by-products are highly important parts of the industry. There are manufacturing enterprises which lose money or only pay expenses on the main output and rely upon the by-products to pay dividends. One of the drawbacks to fruit-growing has been the serious wastes. Not infrequently half of the crop because of unfavorable season, fungi, insects or other causes is unfit for the market. Profits which may be squeezed from such wastes may often be made to pay expenses and even give some profits.

The chief ways of making use of fruit unfit for market is by evaporating, canning, jelly-making, preserving and in the manufacture of cider, vinegar, and spirits. Time does not suffice to take these up separately, and it remains only to be said that in recent years a revolution has been worked in making use of waste fruits. Formerly fruits were dried, canned, etc., only in the home and for home use, or possibly for trading at the country store. For most part the home industry has been given up and the preparation of fruit as above outlined has become a business carried on by specialists. The fruit grower has nothing to do but to deliver his wares to the manufacturing establishment. So important has this matter of utilization of waste products become that fruit manufacturing establishments are now considered an absolute necessity in fruit growing centers. At the last census there were in the United States 30,000 canning and evaporating factories, giving rise to the employment of about 1,000,000 people in the canning season. It must be said, however, that the majority of these were handling vegetables rather than fruit.

There are many other problems that might be discussed here but time forbids. There are, too, other marvels in horticultural progress which might well be set forth, but the examples given are sufficient for illustration. I am well aware that much of the matter here discussed pertains to commerce rather than horticulture, but I again assert that they, the economic factors, are most largely responsible for the phenomenal extension of horticultural interests in recent years.

WHAT ORGANIZATION HAS ACTUALLY ACHIEVED FOR THE AMERICAN FARMER.

NOTES ON AN ADDRESS BY HON. J. K. CAMPBELL OF YPSILANTI.

The facts in regard to farmers' organizations are known to all. Their history is all included in the past fifty years. About thirty-five years ago the Grange had its beginning.

Originated at the close of the civil war to unite the farmers of the north and the south, it did much to unify the sections lately at war.

Its Declaration of Purposes, sent out in the early history of the order, is still the best statement of the demands and the needs of the farmer.

The Farmers' National Congress is another of the active forces at work for the uplifting of the farming class. It considers the great questions of national importance upon which the intelligent citizen should be informed. Most of those in attendance are men and women from the farm. But they were able to take up these large and world-wide topics and treat them in an able manner. This was the direct result of the education that comes through organization.

The influence of farmers on legislation has been greatly increased. Through the efforts of the Grange judicial decisions favoring the people have been secured, the Bureau of Agriculture has been raised to a cabinet department, and the living questions, such as the relations of labor and capital, are being studied and discussed.

President McKinley once said, that in his public career he had often noticed how helpless the farmers were before legislative bodies. This is now all changed. We have legislative committees before every law making body.

Organized effort has brought the daily paper to the farmer's door. It has made possible many lines of influence not before within reach of the farmer. As a result of the uplifting, educating influence of organization, the American farmer is keeping pace with the development of every other interest and fitting himself to be the national juryman of the future.

HELPS TO THE HIGH SCHOOL TEACHERS WHO TEACH NATURAL SCIENCE.

W. J. BEAL.

At a meeting of science teachers, held in Rochester, N. Y., in 1900, when asked what preparation in botany they would wish students to have for entering college, the replies were uniform: As things now are, we prefer students to enter college without any study of botany, on account of the hasty and imperfect work. Professors Spalding and Newcombe and others have been talking with little effect on this subject till they are weary, and long since I gave up attempting to reform the world. The trustees or boards of education are the men we should talk to, for they employ the teachers, and they are not here.

I have had a long experience with students who have been taught botany in high schools and I am sorry to say that I place little value on the work. There are some prominent exceptions. There are great differences in high schools. In too many cases the teaching of botany is shifted from one person to another without any stability from year to year with the prevailing notion that any one can teach a class in botany.

In a few cases the class consists of fifty to sixty persons; in most cases the time for the class is a period of only thirty to forty-five minutes. Little can be accomplished in this way, even with the best of teachers.

The class should not number over twenty-five and the period should be at least ninety minutes, consisting mostly of laboratory work. The teacher must have received thorough training in botany, otherwise the topic had better be omitted entirely and something else put in its place. I believe in permitting a teacher to teach what she likes best.

By no means hurry on the start, but go at the study deliberately as though you had all the time you needed. Be just as particular and thorough as you know how to be, of course urging the pupils to study the plants themselves, and not get a lesson in a text-book. The teacher who is compelled to rely on a text-book had better not be entrusted with the work.

If the teacher is a Douglas Campbell he may begin with the study of the lowest forms, using a compound microscope; otherwise, he better not use a compound microscope.

What can the State Academy do to help teachers of science—especially those who have a fundamental knowledge of the topics they attempt to teach?

They may prepare and read papers; they may ask any number of questions; they can listen to the most capable teachers of the State. If any society can help such teachers, it is certain sections of the Academy. This is the place for you: you have found it at last; avail yourself of its privileges; welcome to the Section of Science Teachers! There may be and should be at every annual meeting discussions covering the best new books, apparatus and a teacher's class where methods of demonstration are the prominent feature.

HOW I KNOW SOME OF OUR TREES IN WINTER.

BY W. J. BEAL.

I never tire of looking at trees and for some years I have been trying to determine what are the one or two, possibly three, leading points peculiar to each species by which I know them. At close range there are many good points to be utilized, but what are the marks that tell the trees as one is rapidly moving through the country on the trolly or steam cars? At such times a tree is only in sight for a very little while and is then lost to view. In the notes here offered, I confine myself entirely to trees as seen during the winter season. The bark of many trees is well marked by the lichens seen on the surface, but during the past winter more especially these marks have largely disappeared on trees that grow in streets of towns or on a College Campus, for the reason that the smoke of great quantities of soft coal has left its impression on every thing it touches.

Only a few of the woody plants of Michigan bear buds that are alternate and two ranked, viz.: American elm, red elm, rock elm, hackleberry, mulberry, basswood, beech, blue beech, and witch hazel. With us witch hazel is a shrub, and mulberry is too scarce to be thought of in this connection. Hackleberry may be distinguished from either of the elms by its bark. Thrifty young branches of elm, when two or three years old, put forth buds from most of the branches. The American elm exhibits this peculiarity in the most marked degree. The form of the top of this species varies so much that one needs to recognize three to five or more types.

The American elm exhibits (1) some twigs bearing alternate two-ranked branches, (2) the twigs are very numerous along the sides of branches even up to two inches in diameter, (3) orioles' nests are often seen on the ends of drooping branches. The top of red elm has fewer branches than those of the American elm, and they are larger and straighter. The branches are leggy, i. e., those from one to two inches in diameter contain few or no smaller twigs.

The young branches of young trees of rock elms are freely supplied with corky ridges, more or less vertical, and the branches are not drooping. When a foot or more in diameter, the ridges of bark of a hackleberry tree are vertical and tortuous, turning one edge nearly straight out from the trunk. These flakes are half an inch wide or less, as wide at the surface as at the base, and often extend outward an inch from the rest of the bark.

The trunk of a small basswood is smooth and the limbs are large and rigid, bearing more or less of the fruit that has decurrent winged bracts; often having sprouts close to the stump.

The bark of most buttonwoods is very thin, showing white spots and streaks; balls of fruit at the top.

Tulip trees bear dry cone-like fruits.

Tamarack has the excurrent stem peculiar to most conifers, but bears no leaves in winter.

Beech trees have very light-colored bark and hold a portion of their thin dead leaves.

The bark on the trunk or large branches of a black cherry is dark and runs transversely or in scrolls.

The bark of the trunk and large limbs of sugar maple and black maple, are alike, not very rough, abounding in lichens that are nearly white, extending transversely about the trunk. The flower buds are small.

The lower or outer branches of silver maple are long and drooping with the tips curving outward; flower buds large.

Red maple grows slower than either of the other two maples named; flower buds large.

Swamp white oak has a ragged, unkempt top peeling off in thin scrolls; old trunks covered with deep sharp-edged ridges of bark.

Bur oak has corky ridges on the young branches.

Pin oak bears large numbers of small branches extending nearly at right angles to the trunk.

The trunks of most white oaks are covered by light-colored flaky bark in narrow vertical ridges. There are several other types of white oak bark, among them one having thin strips attached at one edge, and the strips may be a foot long, three inches wide, less than a quarter of an inch thick and extend one edge from the tree at an angle of ten degrees to thirty degrees.

Beech bark is smooth, the outer twigs very numerous and slender, buds narrow and long.

Kentucky Coffee tree is not common; the limbs are few and the smallest of them are of unusual size; the bark is wavy with one edge of the flakes curling at an angle of five to thirty degrees.

Pepperidge or Tupelo when grown with the top well exposed has numerous small branches extending nearly at right angles from a short main axis.

The Cottonwood grows rapidly and the upper straight thrifty branches are greenish white and diverge at an angle of thirty to forty degrees. The older bark is in stout irregular vertical ridges, v-shaped in section, much like that of the tulip tree.

The large-toothed aspen has a greenish white trunk nearly smooth till eight inches in diameter; upper branches rather large, tortuose; the top of the tree rounded.

The aspen has the branches of the previous summer slender, brown, often drooping; trunk like that of the large-toothed aspen.

OFFICERS—1902-3.

President, Prof. I. C. Russell, Ann Arbor.
Vice Presidents:—
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Section of Botany, Prof. C. F. Newcombe, Ann Arbor.
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Section of Zoology, Prof. Hubert L. Clark, Olivet.
Treasurer, Dr. Raymond Pearl, Ann Arbor.
Secretary, Dr. Jas. B. Pollock, Ann Arbor.

COUNCIL.

The council is composed of the above named officers and all past presidents, who are as follows:

Prof. W. J. Beal, Agricultural College; Prof. W. H. Sherzer, Ypsilanti; Mr. Bryant Walker, Detroit; Prof. V. M. Spalding, Ann Arbor; Dr. Henry B. Baker, Lansing; Prof. Jacob E. Reighard, Ann Arbor; Prof. Charles E. Barr, Albion; Dr. V. C. Vaughan, Ann Arbor.

Local Committee—Prof. F. C. Newcombe, Prof. F. G. Novy, Dr. Raymond Pearl, Dr. Jas. B. Pollock.

PROGRAM OF NINTH ANNUAL MEETING, MICHIGAN ACADEMY OF SCIENCE.

Held at Ann Arbor, Thursday, Friday and Saturday, March 26, 27 and 28, 1903.

GENERAL SESSION.

Thursday, 7 to 10 p. m.—

1. Presidential address—"A Topographic Survey of Michigan," by the president of the academy, Prof. I. C. Russell, Ann Arbor.
2. "A Review of the Glacial Geology of Michigan," Mr. Frank Leverett, Ann Arbor.
3. "A Review of the General Geology of Michigan," Dr. A. C. Lane, Lansing.
4. "The Mineral Resources of Michigan," Hon. Charles D. Lawton, Lawton.
5. "The Chemical Industries of Michigan," Mr. A. H. White, Ann Arbor.
6. "Fish and the Fisheries of Michigan," Prof. J. E. Reighard, Ann Arbor.
7. "The Forests of the Lower Peninsula," Mr. C. A. Davis, Ann Arbor.

Saturday, 8 a. m.—

Final business meeting for election of officers, and any other business that may come up.

SECTION OF AGRICULTURE.

Thursday, 3 to 6 p. m.—Vice President Prof. W. J. Beal, Agricultural College.

1. The Scope of the Agricultural Section of the State Academy of Science. Prof. W. J. Beal, Agricultural College.
2. The Social Phase of the Rural Problem. Mr. K. L. Butterfield, Ann Arbor.
3. What Organization has Actually Achieved for the American Farmer. Hon. J. K. Campbell, Ann Arbor.
4. Aspects of Agriculture as an Industry. Prof. W. O. Hedrick, Agricultural College.

Friday, 8 to 10 a. m.—

5. Animal Husbandry as a Scientific Pursuit. Prof. R. S. Shaw, Agricultural College.
6. The Limitations of Live Stock Experiments. Prof. C. D. Smith, Agricultural College.
7. Present Methods of Soil Study. Prof. J. A. Jeffery, Agricultural College.
8. Forestry From the Economic Point of View. Prof. E. E. Bogue, Agricultural College.

9. The Market Demands upon the Fruit Grower. Prof. U. P. Hedrick, Agricultural College.

10. The San Jose Scale in Michigan Orchards. Prof. L. R. Taft, Agricultural College.

SECTION OF BOTANY.

Thursday, 3 to 6 p. m.—Vice President Prof. F. C. Newcombe, Ann Arbor.

1. The Effect of Dilute and Concentrated Sea Water on Cladophora. (10 minutes.) S. O. Mast.

2. The Osmotic Relations of Algae to Their Environment. (10 minutes.) Howard S. Reed.

3. Protoplasmic Movement in Elodea Canadensis. (10 minutes.) Rena B. Raymond.

4. Structural Variations of Chara. (10 minutes.) Ellen B. Bach.

5. The Latent Period in Traumatropism. (10 minutes.) Geo. P. Burns.

6. Extent of the Sensory Zone for Heliotropism of Terrestrial Roots. (10 minutes.) Darrell H. Davis.

7. Final Demonstration of Thigmotropism in Terrestrial Roots. (10 minutes.) Frederick C. Newcombe.

8. On the Absorption of Water by Foliage Leaves, Including a History of the Subject. (15 minutes.) J. B. Dandeno.

Friday, 8 to 10:30 a. m.—

9. Notes on Michigan Fungi, Including Some New Species of Hymenomycetes. (10 minutes.) B. O. Longyear.

10. The Lichen Genus Physcia. (15 minutes.) E. E. Bogue.

11. Contributions to the Botany of Michigan. (10 minutes.) O. A. Farwell.

12. How I Know Some of Our Trees in Winter. (15 minutes.) W. J. Beal.

13. Some Interesting Hybrid Oaks in the Vicinity of Ann Arbor. (20 minutes.) Chas. A. Davis.

14. Preliminary Account of the Distribution of Quercus Imbricaria in Washtenaw County. (10 minutes.) Chas. A. Davis.

15. The Geographic Distribution of Bog Plants. (15 minutes.) E. N. Transeau.

16. The Succession of Plant Societies in Ypsilanti and Augusta Townships of Washtenaw County. (10 minutes.) Forest B. H. Brown.

17. The New Michigan Oak, Quercus Alexanderi Britt; Its Characteristics and Distribution. (15 minutes.) S. Alexander.

SECTION OF GEOLOGY AND GEOGRAPHY.

Friday, 8 to 10:30 a. m.—Vice President Prof. Mark S. W. Jefferson, Ypsilanti.

1. The Great Illicilliwaet Glacier. (20 minutes.) (Lantern slides.) Prof. W. H. Sherzer, Ypsilanti.

2. The Water Temperature of the Great Lakes. (30 minutes.) Norman B. Conger, of the Weather Bureau Station, Detroit.

3. Shore Features at Kincardine, Ontario. (15 minutes.) Prof. M. S. W. Jefferson, Ypsilanti.

Other papers on Geological subjects will be given in the General Session, Thursday evening, and in the Section of Science Teaching, Friday.

SECTION OF SANITARY SCIENCE.

Thursday, 3 to 6 p. m.—Vice President Prof. Charles E. Marshall, Agricultural College.

1. A Study of the Local Meat Supply. Rev. Caroline Bartlett Crane, Kalamazoo.
2. Dairy Inspection. Charles E. Marshall, Agricultural College.
3. School Hygiene. Dr. Guy L. Kiefer, Detroit.
4. Sanitary Plumbing and House Drainage. T. M. Koon.
5. The Enforcement of Sanitary Measures in Cities and Towns. J. C. Harter.
6. Rabies. G. W. Dunphy.
7. Mosquitoes from the Economic Standpoint. (Lantern slides.) R. H. Pettit, Agricultural College.
8. The Anthrax Toxin. J. W. Vaughan, Ann Arbor.

Friday, 8 to 10:30 a. m.—

9. The Chemistry of the Typhoid Bacillus. May Wheeler, Ann Arbor.
10. Further Researches on the Colon Toxin. Mary F. Leach, Ann Arbor.
11. Diphtheria Toxins. L. M. Gelston, Ann Arbor.
12. The Cultivation of Rat Trypanosomes. W. J. McNeal, Ann Arbor.
13. Studies in Denitrification. S. F. Edwards.
14. Morphological Consideration of Organisms Observed in Nodules of Various Leguminous Plants. B. Barlow.

SECTION OF ZOOLOGY.

Thursday, 3 to 6 p. m.—Vice President Hubert L. Clark, Olivet.

1. Reaction to Light of Infusoria and Rotifera. Prof. H. S. Jennings, Ann Arbor.
2. Food Habits of Hydra. (With demonstrations.) Mr. George Wagner, Ann Arbor.
3. Respiratory Mechanism of Petromyzon marinus. (Lantern slides.) Jean Dawson, Ann Arbor.
4. Variation in the Earthworm. Raymond Pearl and W. N. Fuller, Ann Arbor.
5. Variation and Correlation in Arcella. Raymond Pearl and Frances J. Dunbar, Ann Arbor.
6. The Limits of Difference in Specific and Subspecific Distinctions. (20 minutes.) H. L. Clark, Olivet.
7. The Pearl Organs of the Cyprinidae. (20 minutes.) (Lantern slides.) Prof. J. E. Reighard, Ann Arbor.
8. An Experimental Study of the Spawning Behavior of the Brook Lamprey. (20 minutes.) (Lantern slides.) Prof. J. E. Reighard, Ann Arbor.
9. A Preparation for Dissecting Pans. (5 minutes.) S. O. Mast, Holland, Mich.

Friday, 8 to 10:30 a. m.—

10. The Variability of the Garter Snake (Thamnophis sirtalis). (15 minutes.) W. L. Sperry, Olivet.

11. Snake Notes. (10 minutes.) H. L. Clark, Olivet.
12. An Example of the Action of Organic Selection. Prof. J. Playfair McMurrich, Ann Arbor.
13. Some Observations on the Behavior of the Leech. (10 minutes.) Frances J. Dunbar, Ann Arbor.
14. Phototaxis in Volvox. Dr. S. J. Holmes, Ann Arbor.
15. Affinities of the Fauna of Michigan. Charles C. Adams, Ann Arbor.
16. Notes on Michigan Mollusca. (10 minutes.) Bryant Walker, Detroit.
17. Studies on the Development, Behavior and Distribution of the Genus Gonionemus. (40 minutes.) Dr. L. Murbach, Detroit.
18. Scientific Illustration by Photographic Means. (10 minutes.) Prof. Charles E. Barr, Albion.
19. The Physical Basis of Animal Classification. Dr. J. B. Steere, Ann Arbor.

SECTION OF SCIENCE TEACHING.

Friday, 10:30 a. m. to 12.—Vice President Prof. W. H. Sherzer, Michigan State Normal College.

1. Teaching of Physiography in the High School. (45 minutes.) Prof. Charles E. Dryer, Indiana State Normal.

Discussion:—

From the Standpoint of the High School. (15 minutes.) Supt. H. M. Slauson, Ann Arbor.

From the Standpoint of the Normal. (10 minutes.) Prof. M. S. W. Jefferson, Ypsilanti.

From the Standpoint of the College. (10 minutes.) Prof. C. E. Barr, Albion.

Friday, 1:30 to 5 p. m.—

Friday afternoon the Section of Science Teaching will combine with the Biological Conference of the Schoolmasters' Club in a joint session.

2. Status of Physiographic Teaching in our Michigan High Schools. (15 minutes.) Prof. M. S. W. Jefferson, Ypsilanti.
3. Status of Biological Teaching in our Michigan High Schools. (20 minutes.) Miss Jessie Phelps, Ypsilanti.
4. Helps for High School Teachers of Natural Science. (10 minutes.) Prof. W. J. Beal, Agricultural College.
5. In High School Biological Work What May Be Regarded as Settled by the Discussions and Practice of the Last Quarter Century? (15 minutes.) Prof. V. M. Spalding, Ann Arbor.
6. The Value of Zoology in the High School. (10 minutes.) Mr. J. W. Matthews, Detroit.
7. What I Regard the Greatest Present Need in High School Biology. (5 minutes each.) Prof. J. E. Reighard, Ann Arbor; Prof. W. B. Barrows, Agricultural College; Prof. H. L. Clark, Olivet.
8. Greatest Needs as Felt by the Schools Themselves. (10 minutes.) Miss Mary A. Goddard, Ypsilanti.
9. Report Concerning the Collecting, Identification and Exchange of Natural History Material. (10 minutes.) Prof. W. H. Sherzer, Ypsilanti.
10. The Last Thing Concerning the Consolidation of Small Rural

Schools. Hon. Delos Fall, Albion, Mich., State Superintendent of Public Instruction.

11. Round-Table Discussion of Ways and Means by which the Science Work of our High Schools May Be Strengthened. All who can be present are urgently requested to give this matter the thought which it deserves and to bring in their ideas and suggestions.

BIOLOGICAL CONFERENCE OF THE SCHOOLMASTERS' CLUB.

Friday, 1:30 to 5 p. m.—In joint session with the Section of Science Teaching of the Academy of Science. Chairman of Biological Conference, Prof. F. C. Newcombe; Secretary, Genevieve Derby.

1. The Course in Botany Proposed by the Society for Plant Morphology and Physiology. Mary E. Goddard.

2. The Best Books in Zoology for Laboratory, Recitation and Library. Discussion led by Dr. S. J. Holmes.

3. The Best Books in Botany for Laboratory, Recitation and Library. Prof. Frederick C. Newcombe.

4. Statistics on Biological Teaching in Michigan Schools. Jessie Phelps.

Friday, 5 p. m.—

Round-Table for teachers of Biology, for questions, exhibition of note books, presentation of methods, apparatus, etc. Conducted by Prof. V. M. Spalding, Ann Arbor.

INDEX.

N. B. Beal's Michigan Flora, ferns and seed plants, has a separate index on pp. 137-147.